A DISTRIBUTED LAG ANALYSIS OF ADJUSTMENT OF SIZE OF LABOR FORCE IN SELECTED MAJOR LABOR MARKET AREAS IN THE UNITED STATES

by
MAURICE PFANNESTIEL

Bachelor of Arts
Fort Hays Kansas State College
Hays, Kansas
1960

Master of Science
Oklahoma State University
Stillwater, Oklahoma
1966

Submitted to the faculty of the Graduate College
of the Oklahoma State University
in partial fulfillment of the requirements
for the degree of
DOCTOR OF PHILOSOPHY
May, 1967

A DISTRIBUTED LAG ANALYSIS OF ADJUSTMENT OF

SIZE OF LABOR FORCE IN SELECTED MAJOR

LABOR MARKET AREAS IN THE

UNITED STATES

Thesis Approved:

Joseph J. Klos

Thesis Adviser

Willard T. Anderson

Homer L. Knight

W. Trenton

D. D. Durham

Dean of the Graduate College

ACKNOWLEDGMENTS

I wish to acknowledge the debt of gratitude I owe to Dr. James E. Martin; first, for enhancing my knowledge of econometric methods, and second, for his assistance, guidance, and unselfish donation of time throughout various phases of this dissertation.

Deep appreciation is extended to Dr. Joseph J. Klos, Chairman of my graduate committee, for his supervision and advice during the course of this study and throughout my graduate program. I am also indebted to Dr. Wilton T. Anderson, Dr. Homer L. Knight, and Dr. Rudolph W. Trenton for reading this study and for their helpful suggestions.

Appreciation is extended to Dr. Robert L. Sandmeyer for his counsel and encouragement throughout all phases of the graduate program.

A special note of thanks is given to Mrs. Sharon McNish for her patient cooperation in typing all of the various drafts of the dissertation.

Finally, special thanks are due the author's family, especially the author's parents Mr. and Mrs. Clem Pfannestiel, for their quiet manner of encouragement and understanding throughout the author's graduate and undergraduate programs.

TABLE OF CONTENTS

Chapter		Page
I.	INTRODUCTION	1
	Statement of the Problem	1
	Objectives	5
	Methodology	6
II.	REVIEW OF THE LITERATURE	9
	Introduction	9
	Review of Migration Studies	9
	Review of Labor Force Participation Studies	13
	Review of Additional Labor Mobility Studies	18
	Conclusion	20
III.	LABOR MARKET THEORY	22
	Concept of Labor Supply and Labor Supply Function	22
	Adjustment of Quantity of Labor Supplied to Exogenous Labor Demand Shift	23
	Job Vacancy Thesis	25
	Assumptions Concerning Area Labor Demand, Supply, Equilibrium	31
	Specification of Area Labor Supply Function	32
IV.	DESCRIPTION AND DERIVATION OF THE MODEL	36
	Definition of a Distributed Lag	36
	Development of Autoregressive Least Squares Distributed Lag Model Containing Two Lag Parameters	39
	Reasons for the Existence of a Distributed Lag Relationship	49
V.	EMPIRICAL RESULTS AND INTERPRETATION	51
	Description of the Sample	51
	Description of Experiment One	54
	Description of Experiment Two	64
	Labor Supply Elasticities	74
	Local Labor Market Manpower Policy	80

TABLE OF CONTENTS (continued)

Chapter		Page
VI.	SUMMARY AND CONCLUSIONS	86
	Summary	86
	Conclusions	87
	Suggestions for Further Study	89
	A SELECTED BIBLIOGRAPHY	91
	APPENDIX A	96
	APPENDIX B	121

LIST OF TABLES

Table — Page

V-1. Selected Statistics from an Autoregressive Least Squares Distributed Lag Model Containing Two Lag Parameters in the Estimation of Labor Supply Functions for Fourteen Labor Market Areas, 1960 - 1964 57

V-2. Selected Statistics from an Autoregressive Least Squares Distributed Lag Model Containing Two Lag Parameters in the Estimation of Labor Supply Functions for Fourteen Labor Market Areas, 1960 - 1964 66

V-3. Number of Unfilled Job Openings in Local Public Employment Offices, January 1, 1966 73

V-4. Selected Elasticities of the Labor Force Computed From the Autoregressive Least Squares Regressions Presented in Table V-1 75

V-5. Selected Elasticities of the Labor Force Computed From the Autoregressive Least Squares Regressions Presented in Table V-2 77

LIST OF FIGURES

Figure — Page

1. Adjustment of Quantity of Labor Supplied to Exogenous Labor Demand Shift 24

2. Hypothetical Example of Adjustment of the Quantity of Labor Supplied to a Sustained Increase in Area Mean Wage or Area Job Opportunities 35

3. Illustrated Adjustment Path and Time Shape of the Reaction 37

4. Estimated Adjustment Paths of Actual Area Labor Force Size Towards Equilibrium 70

CHAPTER I

INTRODUCTION

The concept of the labor force is increasingly being utilized and investigated as a meaningful economic variable. It represents a key element in the prosperity of localities, regions, and the nation. Its implications for current public policy is evidenced by recent legislation, such as the Public Works and Economic Development Act of 1965, the Manpower Development and Training Act of 1962 as amended and numerous Congressional hearings such as the Joint Hearings before the Subcommittee on Employment and Manpower on the "1965 Manpower Report of the President," and others.

Several of the recent statistical investigations of labor force responsiveness to changing economic conditions were confined to aggregated data for the national economy. However, it is also recognized that labor force utilization and growth is a basic ingredient of local economic prosperity. Much of the decision making concerning the utilization of labor, both from the employer and employee standpoints, is made within the confines of a local labor market area. Due to these considerations, major local labor market areas will constitute the elementary units to be investigated.

Statement of the Problem

The problem to be investigated can be phrased in terms of the following questions. Does the aggregate size of the local area labor force adjust over time to changes in area labor demand relative to area labor supply conditions? Does the aggregate size of the area labor force adjust concurrently to changes in area labor market conditions, or are there significant lags in the adjustment process? What is the nature of current governmental manpower policy in regard to the adjustment of area labor force size in response to the area's labor market conditions?

Local labor force adjustment over time may be classified into two categories, (1) change in composition, and (2) change in size. This investigation will concentrate on the change in size adjustment, which is primarily the result of two opposite flows. From one point in time to a later point in time the change in the size of a local labor force is the net result of additions to the labor force less withdrawals from the labor force.

Movement into and out of the local labor force can be classified into three main types. First of all, there will be in-migration of workers from other localities and out-migration from the local area being observed. Secondly, due to the aging process of humans, some individual members of the labor force will retire while other individuals graduating or dropping out of school will enter the local labor force. The third type of local labor force inflow and outflow is the result of workers who have, or will have, only a temporary attachment to the labor force. R. C. Wilcock defines this group as secondary workers or the secondary labor force.[1] The important point

---

[1]Richard C. Wilcock, "The Secondary Labor Force and the Measurement of Unemployment," in The Measurement and Behavior of Unemployment, National Bureau of Economic Research (Princeton: Princeton University Press, 1957), pp. 168-9.

to note is that each type of the above-mentioned inflows and outflows is a separate aspect of labor mobility.[2]

The variable which reflects the net effect of these types of labor force mobility is the size of the local labor force. According to Phillip Hauser, "Movement into and out of the labor force frames all other forms of labor mobility."[3] The study will concentrate on this particular aspect of labor mobility in order to keep it within manageable resource limits. Therefore, the dependent variable to be investigated will be the variation in the seasonally adjusted size of the labor force for a selected sample of major labor market areas. The results of this investigation should provide information concerning one of the recommendations made by the President's Committee to Appraise Employment and Unemployment Statistics. The Committee recommended the following:

> There is also the need to determine what, if any, relationship exists between economic trends and the size of the labor force.[4] . . . . The Committee strongly recommends that university and government resources be made available to carry out well-formulated and systematic projects to investigate the relationship between the rate of growth in the labor force and economic developments.[5]

---

[2]For a discussion concerning these aspects of labor mobility, refer to Richard H. Leftwich, The Price System and Resource Allocation (third edition; New York: Holt, Rinehart and Winston, 1966), pp. 287-8; Wilcock, loc. cit.

[3]Phillip M. Hauser, "Mobility in Labor Force Participation," in Labor Mobility and Economic Opportunity, (The Technology Press of Massachusetts Institute of Technology and New York: John Wiley & Sons, Inc., 1954), p. 11.

[4]President's Committee to Appraise Employment and Unemployment Statistics, Measuring Employment and Unemployment, (Washington: U. S. Government Printing Office, 1962), p. 71.

[5]Ibid., p. 72.

The explanation of the independent factors functionally related to labor mobility has largely been based on two theories. According to conventional neoclassical economic theory there is a close link between labor mobility and wage determination. A. L. Gitlow states:

> In the traditional view wage determination and labor mobility are closely related. Actually, they are looked upon as different aspects of a single process. Wage differentials induce movements of labor. Labor mobility, in turn, conditions the wage structure. The equilibrium wage structure is achieved when there is no inducement for any worker to change his job. At that point, an optimum distribution of the labor force among occupations and industries is presumably accomplished.[6]

The interrelatedness of labor mobility and wages also accounts for the allocation of labor among markets. In the words of Hicks:

> The movement of labour from place to place is insufficient to iron out local differences in wages. But the movement does occur, and recent researches are indicating more and more clearly that differences in net economic advantages, chiefly differences in wages, are the main causes of migration.[7]

A second viewpoint expressed in the literature is that the processes of labor mobility and wage determination are separate and distinct.[8] The separate process of labor mobility is governed by the availability of jobs, labor being allocated among markets more or less independently of existing net advantages or wage differences. Since labor mobility is a function of job availability, this viewpoint is referred to as the job vacancy thesis.

---

[6] Abraham L. Gitlow, Labor and Industrial Society (Homewood, Illinois: Richard D. Irwin, Inc., 1963), pp. 228-9.

[7] J. R. Hicks, The Theory of Wages (second edition; New York: St. Martin's Press, 1963), p. 76.

[8] Gitlow, loc. cit.

Gitlow advances a type of synthesis of the conventional theory and the job vacancy thesis. He indicates that both theories are important in the explanation of labor mobility, job attractiveness, especially wage differences, having the greater influence when a labor market approaches full employment, while job availability is the significant influence when there is extensive unemployment.

> The view that workers can be redistributed only by differentials in the net attractiveness of jobs is incomplete. They are reallocated also by differentials in the availability of jobs. When workers are no longer needed, in such instances, it is necessary only to indicate job availability. In sum, the allocation of labor seems to be a function of job attractiveness (with wages and other economic considerations of special importance) and job availability. It may be that the relative significance of these two factors varies with changes in the level of economic activity, so that job attractiveness is more significant during periods of relatively full employment while job availability is more significant during periods of relatively extensive unemployment.[9]

Objectives

In the study of labor markets and labor force behavior, there exists a space relationship between the residence of a worker (or prospective worker) and his place of work. A significant proportion of the United States population reside and work within metropolitan areas. Therefore, one objective is to investigate the flexibility of the labor force within the context of a number of major local labor markets.

The second principal objective is to evaluate the applicability of the use of distributed lag models in the appraisal of labor supply

---

[9] Ibid., p. 291.

adjustments over time. Reference is often made to various immobilities and imperfections of labor markets; however, I am unaware of any attempt to evaluate local area labor markets within a distributed lag framework.

The objectives of the econometric analysis will be to focus on (1) the explanation of <u>variation in area labor force size over time as a function of variation in area job attractiveness and variation in area job availability</u>, and (2) <u>the time required for the area labor force to respond to changes among the independent variables</u>. An area wage variable, an area unemployment rate variable, and an area job vacancy variable will constitute the measures of area job attractiveness and area job availability in this analysis.

Methodology

The elementary units of this investigation will consist of major local labor market areas for which the relevant data are available. Because the major labor market area series, providing estimates of area labor forces and area unemployment rates, was initiated in the year 1960, the recent five-year period from January, 1960, through December, 1964, will be explored.

Empirically a time series approach will be undertaken in an effort to determine significant relationships between variation in the size of an area labor force and variation among the independent variables measuring area job attractiveness and area job availability. A single equation, non-linear, distributed lag multiple regression model will be formulated in order to (1) test statistically specific economic hypotheses and (2) to investigate the possibility of lags in local labor force adjustment.

Limitations

This study will abstract from the interdependent nature of local labor markets. In other words, the problem of general equilibrium will not be treated.

The empirical economic research will be partially handicapped by the lack of relevant available data on the basis of individual area labor markets. The data actually used in this investigation will, in some instances, represent the only available measure of the theoretical economic constructs.

Sources of Data

The main sources of data consulted in the study are as follows:

1. National Industrial Conference Board, Inc., _New Index of Help-wanted Advertising_, Technical Paper Number Sixteen. New York: National Industrial Conference Board, Inc., 1964.

2. U. S. Department of Labor, Bureau of Employment Security, _Area Trends in Employment and Unemployment_, 1962-1966.

3. U. S. Department of Labor, Bureau of Employment Security, _The Labor Market and Employment Security_, 1960-1963.

4. U. S. Department of Labor, Bureau of Labor Statistics, _Employment and Earnings_, 1960-1966.

Plan of Presentation

The introduction with primary emphasis on the statement of the problem and organization of the study will comprise Chapter I.

Chapter II will review the literature so as to summarize empirical research investigating labor mobility and area labor force flexibility and present the related implications for the present study.

The traditional competitive market explanation of the labor supply function and labor mobility will constitute a portion of Chapter III. This chapter will be devoted to local labor market theory which relates to quantity of labor adjustments.

The description and derivation of the single equation, non-linear, distributed lag mutliple regression model will be presented in Chapter IV. Also included will be an analysis of the pertinent reasons as to why this model is applicable to labor market investigation.

Chapter V will contain the results of the statistical application of the regression model.

The conclusions of this investigation and related implications in need of further research will comprise Chapter VI.

CHAPTER II

REVIEW OF THE LITERATURE

Introduction

In the literature of labor force adjustment in response to labor demand and supply conditions, two general types of investigation predominate. These are studies of migration and studies of labor force participation rates. These studies primarily utilize static econometric models with no estimation of the speed of adjustment. In contrast to this procedure, the dynamic econometric model utilized in this study does allow for the estimation of the speed of the adjustment process.

Review of Migration Studies

Bunting investigated worker inflows and outflows of six areas, portions of North Carolina and South Carolina, and also of all the counties of North Carolina, South Carolina, and Georgia.[1] He concentrated on testing the interarea aspect of labor mobility in conjunction with area wage differentials. Bunting posed the problem in the following fashion: "Does labor flow away from geographic areas where wages are low toward those in which they are high?"[2]

---

[1]Robert L. Bunting, "A Test of the Theory of Geographic Mobility," Industrial and Labor Relations Review, XV (October, 1961), pp. 75-82.

[2]Ibid., p. 76.

Expected worker flows should be toward the areas which depict the greater net advantages, which Bunting measures by utilizing area mean quarterly income figures. The mean quarterly income data depict larger mean incomes, \$736 for metropolitan areas compared to \$594 for non-metropolitan areas, and the larger figure of \$851 for the United States as a whole compared with \$654 for the three-state area of North Carolina, South Carolina, and Georgia.

The first portion of the investigation concentrated on six areas, made up of sixteen contiguous counties in central North Carolina and northern South Carolina. Four of the areas contained standard metropolitan areas and two did not. Observation of worker inflows and outflows between each individual area and the South Atlantic geographic census division, referred to as the local area, and between each individual area and the rest of the United States provided the following conclusions. The four county groupings containing metropolitan areas gained workers from the surrounding area of the census division, while both of the two groups of counties containing no metropolitan areas lost workers on balance to the local census division. Concurrently all six areas lost workers to the rest of the Nation.

Similar conclusions followed the second portion of the investigation which similarly analyzed the three-state area of North Carolina, South Carolina, and Georgia. The counties of each of these three states were classified as metropolitan or non-metropolitan on the basis of whether the county did or did not contain a standard metropolitan area, thereby providing six county groups. The non-metropolitan county groups were net losers of workers and two of the three metropolitan county groups experienced a net gain of workers according to the results of labor flows within the three-state area. The six county groups of the three states were net losers of workers to the remainder of the country according to the results of labor flows between each of the county groups and the rest of the nation.

This study illustrated that an important source of augmentation of a metropolitan area's labor force comes from contiguous areas. However, there was no indication of the extent to which the existing balance between labor market demand relative to labor supply within the metropolitan area labor market affects the rate of inflow of workers.

A similar type of investigation was conducted by Raimon.[3] The areas selected were states of the United States for which data concerning net civilian migration, earnings level, and percentage change in employment volume were available for the period 1950 to 1957. The statistical methodology used to determine the degree of association of the variables considered consisted of the computation of rank correlation coefficients.

The following results were reported by Raimon. There existed a distinct positive relationship between net in-migration and above-average income levels and also between net out-migration and below-average income levels. Secondly there was a high degree of association, rank correlation coefficient of .86, between percentage change in population and average annual earnings of the employed. A rank correlation coefficient of .57 was obtained between the percentage

[3]Robert L. Raimon, "Interstate Migration and Wage Theory," The Review of Economics and Statistics, XLIV (November, 1962), pp. 428-38.

change in the state population and the gross weekly earnings of production workers in manufacturing. Finally, a ranking of the states according to their percentage change in employment volume from 1950 to 1957, which Raimon utilizes as an approximation of job vacancies by state, provided a rank correlation coefficient of .89 with a ranking of the states according to their per cent change in population. Raimon concluded on the basis of the above results that interstate mobility conformed to the predicted results of the wage difference model and also with the expectations of the job vacancy model.

Another study[4] using the same data to investigate the variation in the rate of civilian migration between states for the 1950 to 1957 period concluded, "... that the availability of jobs is the principal factor which determines the amount and the direction of interstate migration."[5] Through the use of a multiple correlation model, Blanco's analysis suggested two main determinants of interstate migration of civilian population in the United States. The most important determinant, change in the level of unemployment, accounted for 85 per cent of the variation, and an additional one per cent of the variation was accounted for by changes in the number of Federal military personnel in each state. The residual variation not accounted for amounted to 14 per cent. Other independent variables such as wage levels, per cent change in wage rates, education, climate, etc., had no significant effect on explanation of differences in interstate migration rates.

---

[4]Cicely Blanco, "The Determinants of Interstate Population Movements," _Journal of Regional Science_, V (Summer, 1963), pp. 77-84.

[5]Ibid., p. 77.

Review of Labor Force Participation Studies

Using metropolitan area data and calculating cross-sectional regressions for five age-sex groups, teen-age males, teen-age females, prime age males, married women, and older males, Bowen and Finegan have recently made some interesting conclusions concerning the relationship between the dependent variable, the metropolitan area labor force participation rate, and the independent variable of the area unemployment rate.[6] In general, each regression included as independent variables, in addition to the unemployment rate; earnings, education, color, and a dummy variable to indicate which metropolitan areas were located in the South. Bowen and Finegan computed net regression coefficients for the independent variable, the area unemployment rate, regressed upon the metropolitan area labor force participation rate,

> ...which are interpreted as indicating the effects of a one per cent difference among cities in unemployment rates on intercity differences in participation rates, after the influence of other independent variables included in the analysis has been taken into account.[7]

For the five major age-sex groups and the three census years of 1940, 1950, and 1960, there were 15 such coefficients. Each had a negative sign, and 12 were significant at either the one per cent or five per cent level.

The effect of differential unemployment rates on area labor force participation seemed to be larger in the more recent census years;

---

[6] William G. Bowen and T. A. Finegan, "Labor Force Participation and Unemployment," in Arthur M. Ross (ed.), Employment Policy and the Labor Market, (Berkeley: University of California Press, 1965), pp. 115-61.

[7] Ibid., p. 146.

however, the investigators had no strong evidence to support any one reason for this phenomenon.

> When we focus on differential effects among census years, the finding that stands out is the much stronger impact of intercity differences in unemployment on the labor force participation rates of all groups in both 1950 and 1960 than in 1940.[8]

Time series analysis utilizing aggregate data for the complete economy and also for various age-sex components of the aggregate economy's labor force have substantiated the hypothesis that labor force participation is sensitive to the business cycle.

Two of these recent studies were made by Alfred Tella,[9] in one of which he concludes that:

> ...the net effect of a shrinking job market has been to discourage labor force participation, while an expanding job market has encouraged labor force participation. The female labor force was shown to respond more sensitively than the male labor force to changing job opportunities.[10]

Kenneth Strand and Thomas Dernburg have also published two recent studies, the first[11] of which investigated the responsiveness of labor force participation to the business cycle using aggregate economic

---

[8] Ibid., p. 147.

[9] Alfred Tella, "The Relation of Labor Force to Employment," Industrial and Labor Relations Review, XVII (April, 1964), pp. 454-69; and "Labor Force Sensitivity to Employment by Age, Sex," Industrial Relations, IV (February, 1965), pp. 69-83.

[10] Tella, "Labor Force Sensitivity to Employment by Age, Sex," p. 69.

[11] Kenneth Strand and Thomas Dernburg, "Cyclical Variation in Civilian Labor Force Participation," Review of Economics and Statistics, XLVI (November, 1964), pp. 378-91.

data, and the second[12] of which analyzed the variation in labor force participation over time of the various age-sex components of the aggregate labor force. The independent variables utilized in order to explain variation in labor force participation rates were the employment ratio (the per cent of the adult civilian non-institutional population employed), and the exhaustions ratio (the ratio for new unemployment compensation exhaustions to the adult civilian non-institutional population). The former was utilized as an indicator of labor market tightness and the latter as an indicator of the added inducement of other individuals who are not in the labor force to seek work and therefore become part of the labor force. From the first study emerged the conclusion that as economic activity declines the net effect is worker discouragement and withdrawal from the labor force.

> Thus for the period 1953-62, the rule of thumb that emerges is that the loss of a hundred jobs is roughly associated with a reduction in the size of the measured labor force of 50 persons.[13]

The second study identifies in terms of age-sex classifications which workers are most responsive to changes in employment. And as would be expected, it was found that the participation rates of young males, old males, and females of all ages were most responsive to changes in employment.

---

[12] Thomas Dernburg and Kenneth Strand, "Hidden Unemployment 1953-62: A Quantitative Analysis by Age and Sex," The American Economic Review, LVI (March, 1966), pp. 71-95.

[13] Strand and Dernburg, loc. cit., p. 378.

> Labor force participation is virtually autonomous for males 25-64. However, for the younger and older male groups and for all female groups, participation responds to changes in the level of employment. The direction of change in all cases except for males 55-64 is such that a rise in employment is accompanied by a rise in labor force participation. The responsiveness of labor force participation to changes in employment is greatest for the groups in which the elasticity of group to total employment is high. An increase in employment of 1,000 brings forth additional labor force participation of 454, on the average, so that the fall in unemployment is only 546.[14]

Critique of Recent Evidence

Very recently Jacob Mincer has written a review article[15] in which among other studies he specifically reviews the studies of Bowen-Finegan, Tella, and Dernburg-Strand. He concludes that the net labor force sensitivity to employment demand has been overestimated by both the time series and cross section regression procedures. Mincer's estimate of the net discouragement effect, a loss of a hundred jobs is associated with a decline in the labor force of nineteen workers, is slightly less than half as large as the estimate made by Dernburg and Strand.

> To sum up: positive cycle sensitivity (net 'discouragement" effect) is readily discernible in the annual behavior of the secondary labor force. So is the added-worker response in some of the low-income subgroups. But powerful trend factors and institutional changes continue to dominate the behavior of labor-force groups.[16]

---

[14] Dernburg and Strand, loc. cit., p. 94.

[15] Jacob Mincer, "Labor-Force Participation and Unemployment A Review of Recent Evidence," in Robert A. Gordon and Margaret S. Gordon (ed.), Prosperity and Unemployment, (New York: John Wiley & Sons, Inc., 1966), pp. 73-112.

[16] Ibid., p. 100.

Mincer suggests that such institutional changes as the rise in the federal minimum wage (in 1950, 1956, and 1961), the liberalization of social security benefits, and minimum wages which tend to bar youths of low productivity from the labor market are important factors determining the labor force participation of various secondary labor force groups. He further points out that migration may be a factor influencing the labor force participation rates between areas and that there is a strong likelihood of statistical bias existing in the estimated regression coefficients between the labor force-population ratio and the employment-population ratio. After analyzing various possible measurement errors and biases, Mincer recommends that an index of labor demand statistically independent of labor force measurement be used in the study of labor force behavior.

Although there is agreement among investigators that the unemployment rate affects labor force participation, there remain differences as to the explanation of this phenomenon. Mincer suggests that the unemployment rate may act as a proxy variable reflecting short run cyclical deviations of family income and the market wage rate (also referred to as the short run transitory components of family income and market wage rates) from the normal long run, full employment levels of family income and the wage rate.[17] However, Bowen and Finegan hold the following viewpoint.

> To our way of thinking, it is more helpful to regard the unemployment rate as an important variable in its own right, serving as a measure of the probability than an individual job-seeker who is prepared to invest a given amount in 'search' will not be able to find employment within a given period of time. . .

---

[17] Ibid., pp. 77-80.

> From both the theoretical and policy standpoints, it seems desirable to try to develop separate *ceteris-paribus* estimates of the sensitivity of labor-force participation rates to unemployment rates, wage rates, and other variables.[18]

Additional evidence concerning the effect of the unemployment rate on labor force adjustment will be presented in this investigation.

Review of Additional Labor Mobility Studies

Two additional studies merit summarization. The first, by Hansen,[19] utilizes gross-change data (data which depict gross movements from month to month of individuals into and out of the labor force, employment, and unemployment). The gross additions to, versus the gross reductions in unemployment were determined for recent recessionary periods for the aggregate economy in an effort to determine which flow was the greater. Hansen concludes that the number of gross additions to unemployment increased but in general were completely offset by an increased number of gross reductions in unemployment during the recession periods he studied. His estimates of the gross additions to unemployment compared with the gross reductions in unemployment (both expressed as percentages of the civilian labor force) for the troughs of October 1949, April 1954, and April 1958, are 2.9, 2.4, and 3.1 per cent for the former compared with 2.8, 2.4, and 3.1 per cent for the latter.

---

[18] William G. Bowen and T. A. Finegan, "Discussion," in Robert A. Gordon and Margaret S. Gordon (ed.), *Prosperity and Unemployment*, (New York: John Wiley & Sons, Inc., 1966), pp. 113-114.

[19] W. Lee Hansen, "The Cyclical Sensitivity of the Labor Supply," *The American Economic Review*, LI (June, 1961), pp. 299-309.

The second study, by Gallaway,[20] utilizes a statistical technique which determines the degree of correlation between n series of numbers, where n is greater than two. Gallaway, therefore, was able to empirically study several time series from 1948 to 1960 within three broad classifications: industrial (eight industries), occupational (eight occupational groups), and geographical (eight regions). He measures the degree of correlation between n sectoral time series of wage rates and unemployment rates (e.g., n sectors refers to the eight industries with each industry representing one sector within the industrial classification, etc.) in order to test his conditions for efficient labor allocation.

> In summary, as a first approximation two necessary conditions for efficient intrafactor resource allocation by the labor market are a high degree of positive correlation between sectoral wage rates and a high degree of positive correlation between sectoral unemployment rates.[21]

His conclusion, relevant to this particular study, is that the labor market is a reasonably efficient allocator of the labor resource between regional sectors; however, it is well to note that the regional sectors are broad groupings of states. He states in conjunction with this conclusion that mobility may take the form of direct movement of the unemployed to other labor markets or, particularly in relation to depressed areas, differential rates of in-migration. He concluded

---

[20] Lowell E. Gallaway, "Labor Mobility, Resource Allocation, and Structural Unemployment," The American Economic Review, LIII (September, 1963), pp. 694-716.

[21] Ibid., p. 699.

that very little in-migration into depressed areas compared to a greater amount into expanding areas has had the effect of redistributing unemployment.

Conclusion

Summary

Migration studies attempt to explain the patterns of migration according to income differentials and job vacancy attractions. Labor force participation studies attempt to explain variation in participation rates according to variations in income, the unemployment rate, and the employment-population ratio of the relevant group. This particular study proposes to use an area wage variable, an area unemployment rate variable, and an area job vacancy variable in an attempt to explain variations in area labor force size. Both economic theory and prior empirical work pertaining to this subject indicate the importance of these variables.

Differences

There are several important differences between this study and others available in the literature to date. An innovation of this study is to substitute a measure of unsatisfied labor demand for measures of the satisfied demand for labor (i.e., employment, percentage change in employment, employment-population ratio). In the literature reviewed, the latter variables have often been designated as proxy variables for job vacancies. However, the use of a measure of the unsatisfied demand for labor should result in a more realistic measure of job vacancies. This study will utilize an index of area job vacancies as an independent variable, in lieu of the employment-population ratio, the latter not being independent of labor force measurement. There have been no time-series analyses of labor force adjustment within individual area labor markets such as the present study. The time required for the dependent variable to adjust towards a new equilibrium with respect to changes in the independent variables is a feature of this analysis. Additional evidence of the relationship between the unemployment rate and labor force adjustment will be provided.

CHAPTER III

LABOR MARKET THEORY

Concept of Labor Supply and Labor Supply Function

There are various dimensions to the concept of labor supply. Some of the more obvious dimensions of labor supply are the size of the population, the age-sex composition of the population, hours worked per time period, the efficiency of individual workers,[1] and the attitude of the population towards work. This investigation uses only the number of workers in the labor force of the various labor markets as the measure of area labor supply.

> Unless employment in the locality is highly specialized, the supply of labor will normally include a greater variety of skills and classes of workers than either the supply of labor to an industry or the supply to the average firm. Availability of new workers will depend upon the mobility of workers from other areas and upon the extent to which persons in the area, not normally members of the labor force, can be induced to enter employment.[2]

Therefore, in the establishment of a short-run supply function of labor for a particular geographic labor market, it is assumed that the size of the population, the age-sex composition of the labor force, hours worked per time period, and the efficiency of individual

---

[1] James S. Duesenberry, Business Cycles and Economic Growth (New York: McGraw-Hill Book Company, Inc., 1958), p. 309.

[2] Gordon F. Bloom and Herbert R. Northrup, Economics of Labor Relations (Homewood, Illinois: Richard D. Irwin, Inc., 1958), p. 266.

workers are held constant while the attitude of the population towards work is assumed to be a function of the average wage rate.[3] As the average wage rate increases, other things equal, there will be a greater number of workers supplied per unit of time.

Adjustment of Quantity of Labor Supplied to Exogenous Labor Demand Shift

For analytic purposes, assume the local labor market operates under the conditions of pure competition and that the labor resource is perfectly homogenous.[4] Assume profit and utility maximization are the underlying forces equating supply and demand and that at the beginning of time period one the labor market is in equilibrium; i.e., the value of the marginal product of the labor resource is equal to the mean wage rate. Further assume the supply of labor to be a function of the mean wage rate in the market, the function sloping upward and to the right denoting that additional workers will enter the local labor force at higher wages.

Assume that within time period one an exogenous event occurs increasing the demand for labor; i.e., the demand function D_1D_1 for labor shifts to the right to D_2D_2. A new equilibrium position is achieved within time period two. The result is a positive rate of change of the labor force from time period one to time period two.

---

[3] H. H. Liebhafsky, The Nature of Price Theory (Homewood, Illinois: The Dorsey Press, Inc., 1963), p. 336.

[4] For an analysis of the allocation of labor between two area sub-markets refer to Richard H. Leftwich, The Price System and Resource Allocation (third edition; New York: Holt, Rinehart and Winston, 1966), pp. 291-306.

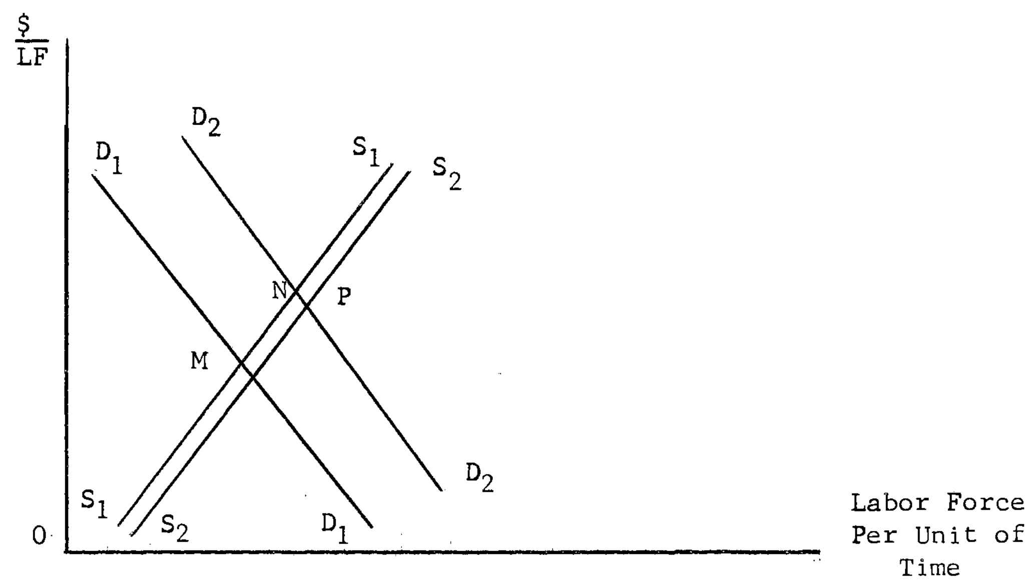

Figure 1. Adjustment of Quantity of Labor Supplied to Exogenous Labor Demand Shift

The adjustment of the labor force to such an exogenous disturbance may conceptually be pictured as two distinct processes. One, an increase in the local labor force participation rate as a result of persons within the market, not normally members of the labor force, being induced into the labor force. This type of adjustment is shown by a movement from point M to point N, a movement from one point to another on the existing labor supply function.

Secondly, due to wage or job vacancy considerations, workers might be induced to migrate into the labor market causing the initial labor supply function S_1S_1 to shift to the right to S_2S_2. This type of adjustment is similar to a movement from point N to point P.

The initial exogenous disturbance might be a leftward shift in labor demand; i.e., the closing of a plant. Opposite labor force adjustment would be in order, either the discouraged worker effect or out-migration. The important aspect to note is that in- or out-migration, or the inducement or discouragement of a net number of individuals into or out of the labor force, will affect the size and rate of growth of the local labor force.

Job Vacancy Thesis

The traditional viewpoint is that the quantity of labor supplied is a function of the average wage rate and that labor mobility, induced by wage differentials, will reallocate the labor resource until equilibrium is achieved; i.e., the demand price is equal to the supply price.

Alternatively, the labor market may be viewed as a mechanism which distributes jobs. The quantity of labor supplied in the short run becomes a function of job opportunities. The link between wage determination and labor mobility as established by traditional economic theory is severed or weakened because of market imperfections and frictions within the labor market.

> Institutional and leadership comparisons are substituted for labor mobility as the main basis for relating wages. Union, employer, and governmental policies are considered more significant sources of wage movements than the traditional action of market forces (supply and demand).[5]

According to this argument there are market imperfections on both the demand side and the supply side of the labor market. On the demand side wage differentials and wage changes are a result of institutional forces such as industry wide union-employer bargaining and current government wage and price guidelines. On the supply side

---

[5]Abraham L. Gitlow, Labor and Industrial Society (Homewood, Illinois: Richard D. Irwin, Inc., 1963), p. 229.

another market friction is the relative immobility of labor for reasons of lack of knowledge, fear, and uncertainty in movement, and inertia. What labor mobility does occur is not in response to wage differentials, for wage differentials need not signify that quantity adjustments are in order. Employers, in the short run, often do not (or cannot) adjust wage rates in order to attract additional labor.

What mobility does exist, especially from non-labor force to labor force status or vice versa, is a function of job opportunities, independent of the wage rate involved. Therefore, it is hypothesized that, for a particular labor market area, short run changes in labor force size are more dependent upon movements of an index of jobs available than upon movements of an index of an average wage.

Employer Behavior in Labor Market

Insight into the interrelationship of the aggregate area variables in question can be gained by considering the components of the aggregates. Concerning the demand for labor, employer behavior is relevant, and concerning the supply of labor, the behavior of the individual resource owner is relevant.

First, consider a few of the explicit alternatives available to an individual employer in the process of hiring for a given set of jobs. The employer may select from several component vectors in order to achieve an optimum adjustment. This can be illustrated by considering the situation of the demand for workers in a particular occupation increasing sharply relative to supply. Firms may have a tendency to raise wages, may experience increased vacancy periods, may accelerate promotion of workers, and may hire workers of lower quality.[6] The reverse is true when labor demand declines relative to supply. Therefore the components are the number of laborers being hired, the base wage rate offered, other net advantages such as fringe benefits and working conditions, quality of the workers considered, the amount of recruiting expenditures, and the vacancy period.[7] The vacancy period is some average time period of unfilled vacancies.

For instance, if an employer desires a given number of additional workers of a specified quality and if institutional factors determine the base wage, fringe benefits, and working conditions, then the employer's adjustment may take the form of lengthening the average vacancy period. However, there is an increasing alternative cost in the form of loss of production associated with lengthening of the average vacancy period. By increasing or decreasing recruiting expenditures (i.e., financing the cost of sending a personnel man to contact prospective workers, cost of advertisement of job vacancies in newspapers and trade journals, etc.) the employer can control, within limits, the length of the average vacancy period.

From an employer's vantage point, increases in the amount of recruiting expenditures as a substitute for increasing the wage rate has already been noted in the literature.

> As George Stigler has pointed out, high wages and high search costs are substitutes for an employer; low-wage employers are therefore forced to use high-cost information channels, such as newspaper advertising and private

---

[6] M. W. Reder, "Wage Structure and Structural Unemployment," Review of Economic Studies, XXXI (October, 1964), p. 310.

[7] Ibid.; William G. Bowen, The Wage-Price Issue a Theoretical Analysis (Princeton: Princeton University Press, 1960), pp. 92-103.

> employment agencies. This hypothesis receives strong support from the findings of Joseph C. Ullman, who has analyzed the Chicago market for two female clerical occupations: typists and keypunch operators. Ullman reports significant negative relationships between wages and the proportion of clerical workers hired through newspaper advertising and private agencies.[8]

Employee Behavior in Labor Market

Employers, however, represent only one-half of the effort of matching labor supply to labor demand conditions. The resource owners themselves, who are able and willing to work, actively engage in job search. Of the individuals so engaged those presently not possessing a job are of course classified as unemployed. In addition, there are individuals not actively engaged in job search who would nevertheless accept employment if job opportunities suited to their particular personal situations and skills were made known to them. These individuals, not statistically counted as unemployed, are often referred to as the secondary labor force.

Job information is particularly important from a worker's point of view in his decision to participate in the labor force or to move from an unemployed status to an employed status. Rationally the individual should engage in job search to the point where the marginal cost of search is equal to the marginal gain derived from additional job search activity. The worker should consider the many detailed conditions associated with all of the jobs available to him; i.e., wage rates, fringe benefits, working conditions, etc.

---

[8] Albert Rees, "Information Networks in Labor Markets," The American Economic Review, LVI (May, 1966), p. 563.

However, in order to deal with the problem of job information and its effect on individual workers, only the number of job vacancies and their associated wage rates are considered, while all other factors are assumed to be constant.[9] The returns from search will depend upon such factors as (a) the amount of search, (b) the distribution of wage offers, and (c) the prospective period of employment.[10] The costs of search depend upon such factors as (a) foregone earnings, (b) transportation costs, and (c) the current state of the labor market; i.e., whether it is expanding or contracting. Therefore, in terms of the behavior of individuals, the amount of search undertaken for a given level of dispersion of employers' wage offers is a direct function of the returns from search and an inverse function of the cost of search.

The dispersion of wage offers undoubtedly is influenced by the institutional factors affecting the wage determination process and the employers' marginal rate of substitution between increases in wage rates and additional recruiting costs. It can be concluded that the

---

[9] This section concerning the returns and costs of job search is based on George J. Stigler, "Information in the Labor Market," The Journal of Political Economy, LXXX Supplement (October, 1962), pp. 96-9.

[10] Ibid., p. 97. Assuming wage offers received from employers are normally distributed, Stigler's approximation of the maximum wage offer received in n searches is:

$$W_M = .65n^{.37}\sigma_W + \bar{W}$$

and the marginal wage rate gain from one additional search is:

$$\frac{dW_M}{d_n} = \frac{.24\sigma_W}{n^{.63}}$$

less the dispersion of wage offers, the less the amount of search undertaken, and the greater the tendency for an individual to accept the initial job, or one of the initial jobs, available to him.

Evidence of this phenomenon is contained in a recent study by Singell[11] of youths in the Detroit labor market. Youths entering the labor market did tend to accept the first job offered to them.

> Approximately 80 per cent of those in Sample 1 took the first job offered, and approximately 95 per cent of those in Samples 2 and 3 did the same.[12]

The large proportion of youths accepting the first position offered them was found to be consistent with the economic behavior of equating the marginal return from additional search activity with the marginal costs of additional search. Singell's computation of the dispersion of wage offers, the coefficient of variation, for the combined samples was from two to five per cent. If on this basis a youth compared the estimated marginal gain in annual wages (calculated to be on the order of $20 to $0.80 for 5 to 20 searches) to marginal costs the same individual incurs hunting for an alternative job (measured at between $8 to $20 a day by using the mean annual wage of the samples), he would at best be indifferent to additional search if he had fortunately located a job in one day.[13]

However, it was observed in the Singell study that even though approximately 90 per cent of the youths accepted the first job offered

---

[11] Larry D. Singell, "Some Private and Social Aspects of the Labor Mobility of Young Workers," The Quarterly Review of Economics and Business, VI, No. 1 (Spring, 1966), pp. 19-27.

[12] Ibid., p. 23.

[13] Ibid., p. 24-25.

them, the youths continued to search for information concerning possible alternative jobs open to them. This indicates considerable potential for improving the allocation of labor resources within local labor markets; for youths generally are able to move and are willing to change jobs. Job vacancy information has an essential role in the improvement of worker mobility and the achievement of a better allocation of the labor resource. In summary, job vacancies in addition to wages may reflect demand for labor forces. An attempt will be made to account for job vacancies in the following development of the supply of labor relationship.

Assumptions Concerning Area Labor Demand, Supply, and Equilibrium

Before discussing the implications of the foregoing behavior of employers and individual resource owners in the context of area labor market theory it is necessary to aggregate the relevant variables. The summation of all area employers' job vacancies, expressed as a proportion of the area labor force, is the area job vacancy rate. The summation of individuals not possessing a job, but who are able and willing to work and actively seeking a job, expressed as a proportion of the area labor force, is the area unemployment rate. Movement of the structure of wages within an area labor market will be discussed in terms of an area mean wage rate.

In terms of a static econometric model it is assumed that the area demand function for labor is a horizontal summation of the area firms' demand functions for labor, considering any market effects of changes in the price of the resource. It is assumed that the area labor demand function will be a decreasing function of the area mean wage and is subject to shifts from time period to time period. In order to provide the rationale for utilizing a single equation statistical model to estimate the effects of various independent variables upon the quantity of labor supplied, it is assumed there exists a relatively stable area labor supply function.[14] The market equilibrium condition can be expressed by stating that firms will adjust quantity of labor input until the wage rate equals the value of labor's marginal product.

Specification of Area Labor Supply Function

Static Formulation

The static area labor supply function is assumed to be an upward sloping function of the area mean wage rate, area job opportunities, and area job attributes. Area job attributes is a term which encompasses such factors as fringe benefits, working conditions, etc., and such factors will be assumed constant for a particular area. Each area will be investigated separately.

$$Q_{Lt} = f(W_t, O_t, Z_t)$$

Therefore the quantity of labor supplied (Q_{Lt}) per time period (t), as measured by the size of the area labor force, is dependent upon the area mean wage rate (W_t), area job opportunities (O_t), and an error term in

[14] Migration could have the effect of shifting the static area labor supply function in the short run and, therefore, the possibility exists that a more elastic area labor supply function, the result of both labor demand function and labor supply function shifts, may be the single equation function postulated in this chapter.

the equation (Z_t). The error term is a stochastic disturbance term which reflects the net effect of omitted variables.

Since the area mean wage rate is, to a degree, assumed to be insensitive to the local labor demand relative to labor supply conditions (based on the previous argument in this chapter), the variable of area job opportunities is hypothesized as the more important in the explanation of variations in area labor force size. The variable of area job opportunities has two aspects. One aspect is the area job vacancy rate.[15] Each job vacancy will possess certain attributes such as: location, wage rate offered, fringe benefits, working conditions, occupation, etc. This is the objective aspect of the job opportunity variable. The second aspect, subjective in nature, of this variable is that workers develop expectations concerning job opportunities.[16] Individuals or groups of individuals which are members of the labor force or prospective members of the labor force establish expectations of being absorbed into employment within a reasonable period of time (assuming, of course, the individual is not presently employed). The expectations of the most mobile groups (all except the hard core employed males, age 25 to 65) are apt to be most affected by area job opportunities. This is one reason the area unemployment rate, an

---

[15] The Bureau of Labor Statistics, Department of Labor, is presently conducting a pilot study to determine the feasibility of the collection and related problems of measurement, reliability, and use of job vacancy statistics. U. S. Congress, Subcommittee on Economic Statistics of the Joint Economic Committee, Hearings, Job Vacancy Statistics, 89th Congress, 2nd Session, May 17-18, 1966, p. 65.

[16] In this context, the job opportunity variable is an ex ante concept, a variable for which the market test of a transaction has not been performed.

inverse index of area job opportunity, could be significant in explaining variations in area labor force size.

The specification of a linear static area labor supply function is:

$$Q_{Lt} = a_0 + a_1 W_t + a_2 V_t + a_3 U_t + Z_t$$

where Q_{Lt} is the size of the area labor force, W_t is an index of the area mean wage rate, V_t is an index of the area job vacancy rate, U_t is the area unemployment rate, and Z_t is the error in the equation.

Dynamic Formulation

Since the time element is such an important factor in the adjustment of labor supply to labor demand conditions, it is imperative that the above model be converted into a dynamic model. The Koyck formulation of a dynamic model makes the dependent variable be a function of not only the current values of the independent variables but also of a series of N past values of the independent variables.

$$Q_{Lt} = a_0 + \sum_{q=0}^{N} a_1 \lambda^q W_{t-q} + \sum_{q=0}^{N} a_2 \lambda^q V_{t-q} + \sum_{q=0}^{N} a_3 \lambda^q U_{t-q} + Z_t$$

where $-1 < \lambda < +1$ and λ is the lag coefficient.
Now the quantity of labor supplied in period t is expressed as a function of the current values of the independent variables and also of N past values of the independent variables. However, the weights assigned to the past values of the independent variables decrease geometrically as the variable recedes in time; i.e., the coefficient of the wage variable lagged q + 1 time periods is λ times the coefficient of the wage variable lagged q time periods.

Adjustment of the Quantity of Labor Supplied
to a Sustained Increase in Labor Demand

Graphically, the equilibrium adjustment of the quantity of labor supplied through time to a sustained increase in the mean wage or to a sustained increase in job opportunities can be depicted by the path of the solid line, Q^E_{Lt}, in Figure 2.

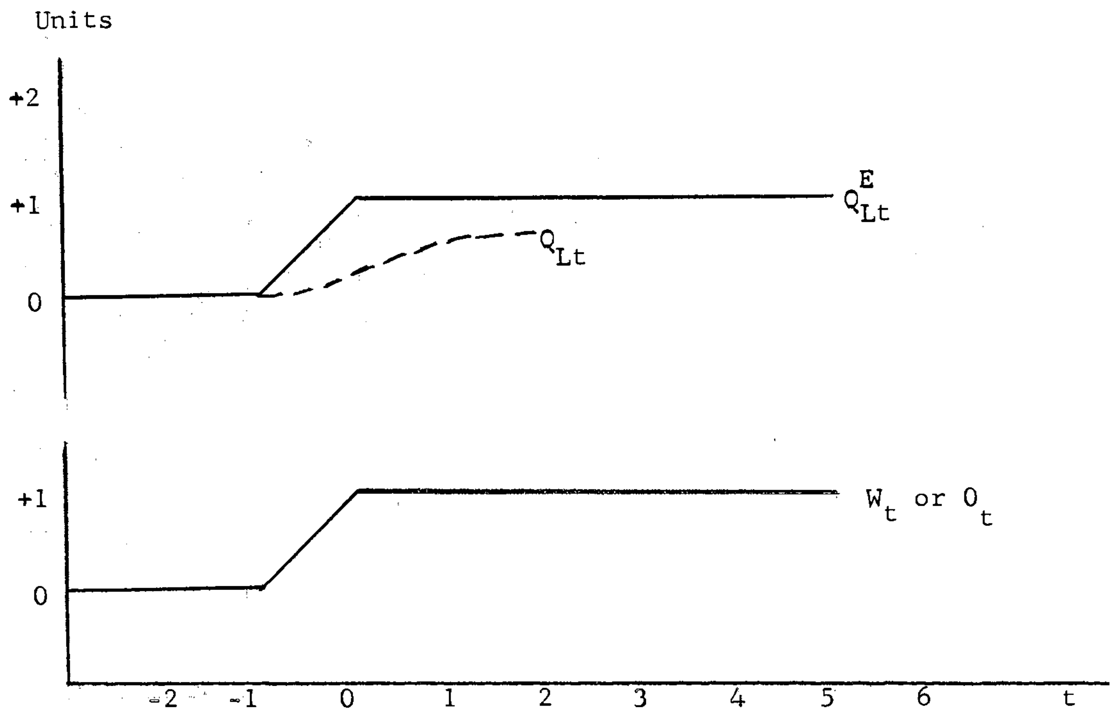

Figure 2. Hypothetical Example of Adjustment of the Quantity of Labor Supplied to a Sustained Increase in Area Mean Wage or Area Job Opportunities

Movement towards equilibrium in the labor market (for reasons discussed in Chapter IV) is assumed to be a lagged adjustment. The hypothetical adjustment path of the actual quantity of labor supplied, Q_{Lt}, to the equilibrium level is depicted by the dotted line in Figure 2. Development of the distributed lag model of the adjustment of actual area labor supply to the equilibrium level is the next task.

CHAPTER IV

DESCRIPTION AND DERIVATION OF THE MODEL

Definition of a Distributed Lag

In the establishment of an appropriate econometric model for the purpose of studying the economic behavior of firms, individuals, and other economic entities, the time element assumes a great deal of importance. In order to explicitly account for time, it is often necessary to resort to a dynamic economic model.

> In economics, cause often produces its effect only after a lapse of time. . . . The lapse of time between a cause and its effect is called a lag. The lag may be a specified time, say three months, or one year. But in many cases, the effects of an economic cause are spread over many months, or even many years. In such cases, we have a distributed lag.[1]

Adjustment Path and Rate of Adjustment

It is very important to determine whether the dependent variable adjusts simultaneously with sustained changes in the independent variable, that is, within the time period in which the variables were measured for the investigation, or whether the adjustment takes place over a series of time periods. Not only is the adjustment path of

---

[1]Marc Nerlove, Distributed Lags and Demand Analysis for Agricultural and Other Commodities, Agriculture Handbook No. 141 (Washington, D. C.: United States Department of Agriculture, 1958), p. 1.

the dependent variable important but also the rate of adjustment. Therefore, Koyck[2] depicts both the adjustment path of the dependent variable and the time shape of the reaction of the dependent variable (y) to the independent variable (x).

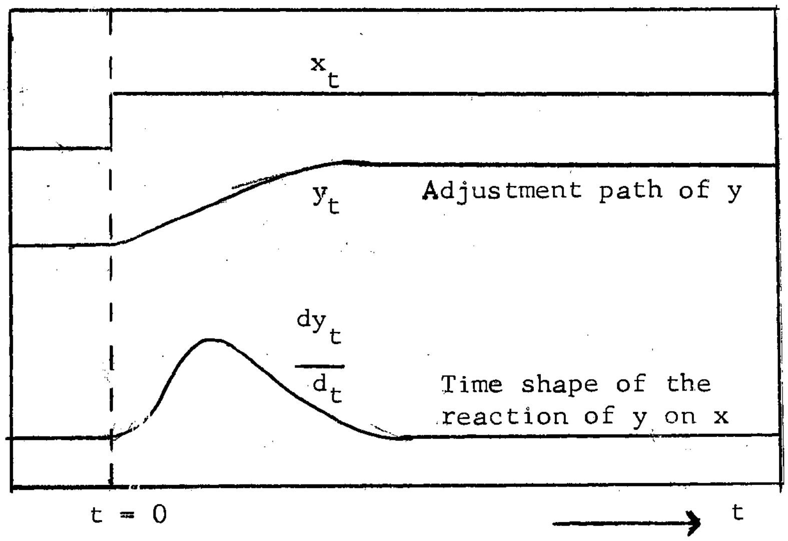

Figure 3.[3] Illustrated Adjustment Path and Time Shape of the Reaction.

We define the time-shape of the reaction of y to x as the time series of the change in y per unit of time caused by a change in x; in Figure 3, this time-shape is given by the curve .[4]

$$\frac{dy_t}{d_t}$$

[2] L. M. Koyck, Distributed Lags and Investment Analysis, (Amsterdam: North-Holland Publishing Company, 1954), p. 9.

[3] Ibid., p. 10.

[4] Ibid., p. 9.

Approximation of the Distributed Lag Relationship

A distributed lag relationship, such as the adjustment path of y_t to x_t can be written:

$$(1) \qquad y_t = f(x_t, x_{t-1}, x_{t-2}, \ldots).$$

A linear approximation of equation (1) is:

$$(2) \qquad y_t = \alpha_0 x_t + \alpha_1 x_{t-1} + \alpha_2 x_{t-2} + \ldots.$$

Equation (2) can be written:

$$(3) \qquad y_t = \sum_{i=0}^{\infty} \alpha_i x_{t-i}$$

where α_i are referred to as the reaction coefficients. The least squares linear estimation of the parameters expressed by equation (2) will in general provide unreliable estimates because of the presence of high multicollinearity among the independent variables. Therefore, Koyck introduces the assumption that the reaction coefficients be approximated by a converging geometric series. The coefficients of equation (2) therefore can be expressed as:

$$(4) \qquad \alpha_{i+1} = \lambda\alpha_i \qquad\qquad -1 < \lambda < +1$$

Equation (4) need not hold for all i, but only for $i \geq k$.

The lag coefficient (λ) is restricted to be between a minus one and a plus one in order to insure a stable equilibrium. If the lag coefficient is zero, the complete adjustment process occurs within the individual measured units of time selected for the investigation. If the lag coefficient is positive and significantly different from zero, then there is a lagged adjustment over time of the dependent variable to a change in the independent variable. (In other words, the adjustment is not completed in one period.) If the lag coefficient is negative and significantly different from zero, then there is an over adjustment of the dependent variable in response to a change in the independent variable. (In other words, the adjustment is greater in one period than the equilibrium adjustment will be for all periods.)

Development of Autoregressive Least Squares Distributed Lag Model Containing Two Lag Parameters

Derivation of the Model

The statistical model used in this investigation is an autoregressive least squares model containing two lag parameters. It is developed from a simple static multiple regression model of the form:

$$(5) \qquad Y_t = a_0 + \sum_{i=1}^{A} a_i X_{it} + \sum_{j=1}^{B} b_j X_{jt}.$$

The subscript t refers to time and subscripts i and j refer to two sets of independent variables.

However, the formulation of the dynamic model in the previous chapter postulated a distributed lag relationship between the area labor force size and the independent variables. Current area labor force size was assumed to be a function not only of the current value of the independent variables, i.e., the functional form of equation (5); but also of all past values of the independent variables. Therefore two separate lag coefficients, lambda (λ) and mu (μ), will be introduced into the model. Lambda (λ) will be associated with the past values of one set of independent variables and mu (μ) with the past values of the second set of independent variables. Each lag coefficient is assumed to decline exponentially through time and each varies between minus one and plus one, i.e., $-1 < \lambda, \mu < +1$. After introducing the lag coefficients, the Koyck form of the distributed lag regression, assuming lag λ is associated with the independent variable(s) X_{it} and lag μ is associated with the independent variable(s) X_{jt}, is as follows:

$$(6) \qquad Y_t = a_0 + \sum_{i=1}^{A} \sum_{q=0}^{\infty} a_i \lambda^q X_{it-q} + \sum_{j=1}^{B} \sum_{q=0}^{\infty} b_j \mu^q X_{jt-q} + W_t$$

In order to reduce equation (6) into a form suitable for estimation it is necessary to proceed as follows. First, lag equation (6) by one time period. Second, multiply the result of step one by λ. Third, subtract the result of the second step from equation (6). Fourth, lag the result of step three by one time period. Fifth, multiply the result of step four by μ. Sixth, subtract the result of the fifth step from the result of step three. The result is equation (7):

$$(7) \qquad Y_t = a_0(1-\lambda)(1-\mu) + \sum_{i=1}^{A} a_i X_{it} - \mu \sum_{i=1}^{A} a_i X_{it-1} + \sum_{j=1}^{B} b_j X_{jt} - \lambda \sum_{j=1}^{B} b_j X_{jt-1} + (\lambda+\mu) Y_{t-1} - \lambda\mu Y_{t-2} + U_t$$

where $U_t = W_t - (\lambda+\mu) W_{t-1} + \lambda\mu W_{t-2}$.

Assume the errors of equation (7) follow a first order autoregressive pattern of:

$$U_t = \beta U_{t-1} + e_t \qquad \text{where} \qquad -1 < \beta < +1.$$

Lag equation (7) by one time period and then multiply this lagged equation by beta (β). Then subtract the result from equation (7). This procedure results in equation (8).

$$(8) \qquad Y_t = a_0 (1-\lambda)(1-\mu)(1-\beta) + \sum_{i=1}^{A} a_i X_{it}$$

$$- (\mu+\beta) \sum_{i=1}^{A} a_i X_{it-1} + \mu\beta \sum_{i=1}^{A} a_i X_{it-2}$$

$$+ \sum_{j=1}^{B} b_j X_{jt} - (\lambda+\beta) \sum_{j=1}^{B} b_j X_{jt-1}$$

$$+ \lambda\beta \sum_{j=1}^{B} b_j X_{jt-2} + (\lambda+\mu+\beta) Y_{t-1}$$

$$- \left[(\lambda+\mu)\beta + \lambda\mu\right] Y_{t-2} + \lambda\mu\beta Y_{t-3} + e_t$$

Equation (8) is the general form of the equation to be estimated.

Assumptions of the Model

By introducing the assumption of a first order autoregressive scheme, it is now assumed that the e_t (residual errors) are non-autocorrelated, of constant variance, and uncorrelated with the predetermined variables of the model. The assumptions concerning e_t of equation (8) are:

$$E\,(e_t e_{t-q}) = 0 \qquad q \neq 0$$

$$E\,(e_t^2) = \sigma^2 \qquad \text{all } t$$

$$E\,(X_{i_t} e_t) = 0 \qquad \text{all } i$$

$$E\,(X_{j_t} e_t) = 0 \qquad \text{all } j$$

$$E\,(Y_{t-q} e_t) = 0 \qquad q \geq i$$

Properties of the Estimates

According to Martin,[5] consistency and asymptotic normality are properties of the final estimates of the autoregressive least squares estimation procedure assuming (a) the X_{it} and X_{jt} are bounded and (b) the e_t are normally distributed. The estimates are also maximum likelihood estimates which are efficient if the likelihood function is unimodal.

> The A.L.S. estimation procedure insures that the non-linear restrictions on the coefficients of the autoregressive equation are fulfilled. Therefore, if the X_{it} are bounded and the e_t are normally distributed, the final set of estimates for the vector, P_i, possess the large sample properties of consistency and asymptotic normality. In addition, if the likelihood function is unimodal, the estimates, P_i, become maximum likelihood estimates which are efficient. However, if the likelihood function possesses local maxima, the A.L.S. estimation procedure does not insure that the final set of estimates, P_i, occur at the global maximum.[6]

Estimation of the Model

If ordinary least squares estimation is applied directly to equation (8), there will result multiple and conflicting estimates

---

[5] James E. Martin, "An Application of Distributed Lags in Short-Run Consumer Demand Analysis" (unpublished Ph.D. dissertation, Department of Agricultural Economics, Iowa State University), pp. 48-9.

[6] Ibid., pp. 48-9.

of the original parameters. Assuming there are only two independent variables, X_i and X_j, there will result ten estimated coefficients while there are only six unknown parameters. Therefore, an iterative estimation procedure will be utilized in order to obtain unique estimates of the six unknown parameters.

The following discussion is a general outline of the detailed estimation procedure of an autoregressive least squares model assuming first order autocorrelation of errors. The detailed procedure is described by Fuller and Martin,[7] and by H. O. Hartley.[8]

In this discussion it is assumed that the data have been corrected for the mean, i.e., the raw observations of each variable are expressed as deviations from their respective means. It is also assumed for simplification purposes that there are only two independent variables, X_i and X_j. Utilizing corrected data, equation (8) can be written as follows:

$$
\begin{aligned}
(9) \quad y_t = {} & a_i x_{it} - (\mu+\beta)\, a_i x_{it-1} + \mu\beta\, a_i x_{it-2} + b_j x_{jt} \\
& - (\lambda+\beta)\, b_j x_{jt-1} + \lambda\beta\, b_j x_{jt-2} + (\lambda+\mu+\beta)\, y_{t-1} \\
& - \left[(\lambda+\mu)\beta + \lambda\mu\right] y_{t-2} + \lambda\mu\beta\, y_{t-3} + e_t
\end{aligned}
$$

---

[7] Wayne A. Fuller and James E. Martin, "The Effects of Autocorrelated Errors on the Statistical Estimation of Distributed Lag Models," Journal of Farm Economics, XLIII, No. 1 (February, 1961), pp. 71-82.

[8] H. O. Hartley, "The Modified Gauss-Newton Method for the Fitting of Non-Linear Regression Functions by Least Squares," Technometrics, III, No. 2 (May, 1961), pp. 269-80.

An approximation of y_t of equation (9) can be achieved by the use of a multiple first order Taylor expansion where the vector $\theta_0 = \left[a_{i0}, b_{j0}, \lambda_0, \mu_0, \beta_0\right]$ represents initial arbitrarily selected guesses (values) for the unknown parameters a_i, b_j, λ, μ, and β.

$$(10) \quad y_t - y_{t0} = Z_{10}\,\Delta a_{i0} + Z_{20}\,\Delta b_{j0} + Z_{30}\,\Delta\lambda_0 + Z_{40}\,\Delta\mu_0 + Z_{50}\,\Delta\beta_0 + g_t$$

where

$$\begin{aligned} y_{t0} = {} & a_{i0}x_{it} - (\mu_0 + \beta_0)\, a_{i0}x_{it-1} + \mu_0\beta_0\, a_{i0}x_{it-2} \\ & + b_{j0}x_{jt} - (\lambda_0 + \beta_0)\, b_{j0}x_{jt-1} + \lambda_0\beta_0 b_{j0}x_{jt-2} \\ & + (\lambda_0 + \mu_0 + \beta_0)\, y_{t-1} - \left[(\lambda_0 + \mu_0)\,\beta_0 + \lambda_0\mu_0\right] y_{t-2} \\ & + \lambda_0\mu_0\beta_0\, y_{t-3} \end{aligned}$$

$$Z_{10} = x_{it} - (\mu + \beta)\, x_{it-1} + \mu\beta x_{it-2}$$

$$Z_{20} = x_{jt} - (\lambda + \beta)\, x_{jt-1} + \lambda\beta x_{jt-2}$$

$$Z_{30} = -b_j x_{jt-1} + \beta b_j x_{jt-2} + y_{t-1} - (\mu + \beta)\, y_{t-2} + \mu\beta y_{t-3}$$

$$Z_{40} = -a_i x_{it-1} + \beta a_i x_{it-2} + y_{t-1} - (\lambda + \beta)\, y_{t-2} + \lambda\beta y_{t-3}$$

$$\begin{aligned} Z_{50} = {} & -a_i x_{it-1} + \mu a_i x_{it-2} - b_j x_{jt-1} + \lambda b_j x_{jt-2} + y_{t-1} \\ & - (\lambda + \mu)\, y_{t-2} + \lambda\mu y_{t-3} \end{aligned}$$

The Z_{i0} are the first derivatives of equation (9) with respect to each unknown parameter. The vector $\Delta\theta = \left[\Delta a_{i0}, \Delta b_{j0}, \Delta\lambda_0, \Delta\mu_0, \Delta\beta_0\right]$ represents the deviations of the initial guesses (values) from the true parameters. An estimate of the vector $\Delta\theta$ is obtained by computing the regression of $y_t - y_{t0}$ on the Z_{i0}. If the estimated deviations (the vector $\Delta\theta$) thus obtained are not small, the process is repeated using the vector θ_1 as the second set of guesses (values);

$$\theta_1 = \left[(a_{i0} + k\widehat{\Delta a}_{i0}),\ (b_{j0} + k\widehat{\Delta b}_{j0}),\ (\lambda_0 + k\widehat{\Delta\lambda}_0),\ (\mu_0 + k\widehat{\Delta\mu}_0),\ (\beta_0 + k\widehat{\Delta\beta}_0)\right].$$

The damping parameter k is defined as:

$$k = (1/2)^d \qquad\qquad d = 0, 1, 2 \ldots$$

where d represents the trial number.[9] Denote the SSE (sum of squares for error) for the vector θ_0 as $Q(0)_{d+1}$ and for the vector θ_1 by $Q(k)_{d+1}$. For trial number zero, $k = 1$. Compute $Q(1)_{d+1}$. If this is less than $Q(0)_{d+1}$, the sum of squares for error at the start point, then use the vector θ_1 with $k = 1$ as the start values for the second iteration. If $Q(1)_{d+1}$ is greater than $Q(0)_{d+1}$, attempt trial number one where $k = 1/2$. Compute $Q(1/2)_{d+1}$ and compare it with $Q(0)_{d+1}$; if less, use the vector θ_1 with $k = 1/2$ as the start vector for the second iteration; if not, attempt trial number two where $k = 1/4$, etc. The start vector for the second iteration is

[9] Wayne A. Fuller and James E. Martin, "A Note on the Effects of Autocorrelated Errors on the Statistical Estimation of Distributed Lag Models," Journal of Farm Economics, XLIV, No. 2 (May, 1962), pp. 407-10.

given by $\theta_1^{\prime}$ where k is the largest value in the geometric series 1, 1/2, 1/4, . . . such that:

$$Q\ (k)_{d+1} < Q\ (0)_{d+1}$$

The above procedure of utilizing the damping parameter k insures convergence of solution, i.e., the sum of squares for error associated with the final estimates of the parameters is at least a local minimum.

Iteration is carried on until the estimated deviations (the vector $\Delta\theta_i$) become insignificantly small. A relatively insignificant change in any of the deviations contained in the vector $\Delta\theta_i$ is defined in terms of the following test criterion.

$$(11) \qquad t_i^2 = \frac{(\Delta\theta_i)^2}{\mathrm{Var}\ (\theta_i)} < .001 \text{ for all } i.$$

The value .001 is selected arbitrarily and depends on the accuracy needed in the problem.

Statistical Tests

For the purpose of testing the significance of the estimated parameters, it is necessary to compute their variances and co-variances. Estimation of the large sample variances and covariances is achieved by computing the product of the estimated variance (s^2) times the elements of the inverse matrix of the sums of squares and cross products of first derivatives; i.e., c_{ij} of the $(ZZ')^{-1}$ matrix. The estimated variance (s^2) is:

$$(12) \qquad s^2 = \frac{\sum_t (y_t - \hat{y}_t)^2}{n - r}$$

where n is the number of observations and r is the number of parameters estimated.[10]

The statistical t test will then be used in order to test whether the estimated parameters are statistically different from zero at various levels of confidence. It should be noted at this point that the statistics obtained by an autoregressive least squares iterative procedure are only asymptotic estimates and therefore exact t and F tests cannot be performed.

Elasticity and Time Required for Adjustment

The estimated short-run elasticity (SRE) of the dependent variable to each of the independent variables can be computed by the use of the following formulas:

$$(13) \qquad SRE_i = a_i \frac{\bar{X}_i}{\bar{Y}} \qquad i = 1, \ldots, A$$

$$(14) \qquad SRE_j = b_j \frac{\bar{X}_j}{\bar{Y}} \qquad j = 1, \ldots, B$$

In addition this model can provide estimates of the long-run elasticity (LRE) of the dependent variable with respect to each of the independent variables. The following relationships exist

---

[10] Fuller and Martin, op. cit., p. 75.

between the estimates of short-run elasticity and the estimates of long-run elasticity. If the appropriate lag coefficient is equal to zero, then the short-run elasticity is equal to the long-run elasticity. If the appropriate lag coefficient is greater than zero but less than plus one, then the short-run elasticity is less than the long-run elasticity. If the appropriate lag coefficient is greater than minus one but less than zero, then the short-run elasticity is greater than the long-run elasticity.

$$(15) \qquad LRE_i = \left[\frac{a_i}{1 - \lambda} \right] \left[\frac{\bar{X}_i}{\bar{Y}} \right] \qquad i = 1, \ldots, A$$

$$(16) \qquad LRE_j = \left[\frac{b_j}{1 - \mu} \right] \left[\frac{\bar{X}_j}{\bar{Y}} \right] \qquad j = 1, \ldots, B$$

The lag coefficient provides an estimate of the time it takes for the dependent variable to adjust to a new long-run equilibrium in response to a sustained change of an independent variable. Complete adjustment would require an infinite amount of time. But suppose N represents the number of periods necessary to achieve an adjustment within five per cent of the long-run equilibrium level, then N can be estimated by the use of the following formula:

$$(17) \qquad (\lambda)^N \leq .05$$

where λ is the appropriate lag coefficient.

Reasons for the Existence of a Distributed Lag Relationship

The economic variables which affect the supply of labor may do so with a distributed lag for several reasons.

> The reasons fall into three broad groups: (1) psychological, (2) technological, and (3) institutional. Typically some conjunction of factors falling in all three groups operate to produce a distributed lag.[11]

Relevant to this grouping of factors is the discussion of Leftwich[12] concerning nonprice impediments which impinge on resource allocation in response to labor demand conditions. Leftwich's classification of nonprice impediments are: (1) ignorance, (2) sociological and psychological impediments, and (3) institutional factors. The resource owners' lack of knowledge concerning existing job opportunities; " . . . those ties to particular communities, to friends, and to the family which restrict mobility . . ."[13]; and (a) pension and seniority rights, (b) union restriction of worker entry into particular occupations, and (c) licensing requirements are examples of factors which prevent immediate labor force adjustment and give rise to a distributed lag type of adjustment.

---

[11] Nerlove, op. cit., p. 5.

[12] Leftwich, op. cit., pp. 300-301.

[13] Ibid., p. 301.

> Time is required for the flow of job information and for matching the location, education, skill, wage, working conditions, and other preferences of job-hunters with the requirements of employers.[14]

Heller highlights additional reasons why the adjustment process is likely to be spread out over several time periods[15]: (1) the Employment Service is unable to provide complete information on local job opportunities; (2) young workers are not properly prepared to be absorbed immediately into job activity in which employment is rapidly expanding because of inadequate vocational guidance; and (3) geographic movement is inhibited due to lack of information and lack of funds to finance transportation, job search, and change of residence.

In conclusion, it is precisely due to the many imperfections that do exist within and among area labor markets that a distributed lag model is being used for the empirical investigation. The adjustment of an area labor force to area labor demand conditions, contrary to displaying a constant lag, can more properly be characterized as being distributed over several time periods.

---

[14]Walter W. Heller, "Employment and Manpower," in Stanley Lebergott (ed.), Men Without Work The Economics of Unemployment, Englewood Cliffs, New Jersey: Prentice-Hall, Inc., 1964), p. 88.

[15]Ibid., pp. 88-9.

CHAPTER V

EMPIRICAL RESULTS AND INTERPRETATION

Description of the Sample

One of the original objectives of this investigation was to study labor force responsiveness relative to labor demand conditions within the context of major local labor market areas. Many of the previous labor market investigations use completely aggregated data for the national economy, i.e., the labor market is defined as the whole nation. It is contended that a study of labor force flexibility on a less aggregated geographical basis will provide important information, which heretofore has been unavailable, for current and prospective manpower policy. The term labor market in this particular study is defined in terms of a standard metropolitan statistical area.

> A local labor market area may be defined as a geographic area consisting of a central city (or cities) and surrounding territory in which there is a concentration of urban economic activity or urban labor demand in which workers can generally change jobs without changing their residence.[1]

The key element is that an individual is able to change his place of work without changing his residence.

---

[1] Louis Levine, "Unemployment by Locality and Industry," in The Measurement and Behavior of Unemployment, National Bureau of Economic Research (Princeton: Princeton University Press, 1957), p. 328.

In attempting to do a study on an individual labor market basis, one of the problems encountered is the scarcity of relevant data. Fortunately, by relying on several sources, time series data on the basis of individual labor market areas were available for the five-year period 1960 to 1964. The two principal criteria, phrased in terms of questions, for the selection of a particular labor market area to be included in the sample were: (1) Are the relevant data available? and (2) Have there been any significant revisions in the time series involved so as to cause the data of a portion of the series to be incomparable with the same information of a different portion of the series? The twenty-two labor market areas selected satisfactorily met the above criteria of an answer of yes to the first question and an answer of no to the second question. This number is considered to be a reasonable sample size in relation to (1) the limited resources available to conduct the study and (2) that approximately fifteen of the possible fifty-two labor markets (for which data were available or partially available) did not meet the criteria established for selection. The labor market areas included in sample are: Washington, District of Columbia; Richmond, Virginia; Rochester, New York; Denver, Colorado; Omaha, Nebraska; Jacksonville, Florida; Atlanta, Georgia; Columbus, Ohio; Oklahoma City, Oklahoma; Dayton, Ohio; Salt Lake City, Utah; Pittsburgh, Pennsylvania; San Diego, California; Miami, Florida; Providence-Pawtucket, Rhode Island; Detroit, Michigan; Philadelphia, Pennsylvania; San Bernardino, California; Newark, New Jersey; Birmingham, Alabama; Seattle, Washington; and New Orleans, Louisiana. In terms of the broad regional classification used by the

National Industrial Conference Board,[2] the twenty-two labor market areas are distributed geographically as follows: New England - one; Middle-Atlantic - four; South Atlantic - five; East North Central - three; West North Central - one; East South Central - one; West South Central - two; Mountain - two; and Pacific - three.

Computing the mean unadjusted unemployment rate over the five-year period of each of the twenty-two labor markets, and using the Bureau of Employment Security's classification system,[3] we find that the twenty-two labor markets fall into the various classifications as follows: none in A, two in B, ten in C, ten in D, none in E, and none in F. Therefore, there is a reasonable cross section of areas represented in the sample on the basis of each area's unemployment rate. Only under unusual local area conditions is a market classified in the A classification and the unemployment rate must be over nine per cent for an area to be classified in either the E or F group.

---

[2]National Industrial Conference Board, Inc., New Index of Help-wanted Advertising, Technical Paper Number Sixteen (New York: National Industrial Conference Board, Inc., 1964), pp. 8-9.

[3]U. S. Department of Labor, Bureau of Employment Security, Area Trends in Employment and Unemployment, January-February, 1966, p. 1.

Labor Supply Category	Description	Unemployment Rate
Group A	Overall labor shortage	Less than 1.5%
Group B	Low unemployment	1.5 to 2.9%
Group C	Moderate unemployment	3.0 to 5.9%
Group D	Substantial unemployment	6.0 to 8.9%
Group E	Substantial unemployment	9.0 to 11.9%
Group F	Substantial unemployment	12.0 or more

> The unemployment rate is a key factor in determining the area classification, but consideration is also given to the area's employment and unemployment outlook, local employer estimates of their manpower requirements, the relationship between labor supply and demand, the seasonal pattern of employment and unemployment fluctuations in the area, and other factors.[4]

Based on the above classification system used by the Bureau of Employment Security, the sample does contain a group of labor markets with diverse conditions, some with low to moderate unemployment, some with substantial unemployment.

Description of Experiment One

Functional Relationship

After the selection of the sample, experiment one was conducted. The statistical model used to estimate the population parameters involved was equation eight of Chapter IV. The dependent variable, the seasonally adjusted size of the area labor force, represents the empirical measure of the quantity of labor supplied in a specified area for a specified time period. It was hypothesized in experiment one that fluctuations in the quantity of labor supplied over time in a specified labor market area could be explained by fluctuations over time of the following independent variables: the area mean wage rate as measured by the average hourly earnings of production workers in manufacturing, area job opportunities as measured by (a) the area help-wanted advertising index and by (b) the seasonally adjusted unemployment rate of the specified area.

---

[4] Ibid., p. 1.

Expectations

The expected results of experiment one were as follows. It was expected that as the area mean wage increased there would be a corresponding increase in the quantity of labor supplied. However, if the wage determination process is independent of labor supply relative to labor demand conditions of a particular area labor market, then it can be expected that changes in area mean wage rates are, in general, independent of changes in the quantity of labor supplied within the area.

The second independent variable, the area index of help-wanted advertising, can also be expected to have a positive impact on the size of an area labor force. A rising help-wanted advertising index can be attributed to expanding firms in the areas which are experiencing difficulty in the hiring of employees of a desired quality through informal market information channels. In order to fill a job vacancy, one of the alternatives open to an employer is to incur the cost of providing the information about job vacancies and the related job standards to the prospective interested individuals. The end result, in an expanding labor market area, would be an increase in the area help-wanted advertising index and a subsequent increase in the quantity of labor supplied in the area.

The rationale underlying an expected negative relationship between changes in the area seasonally adjusted unemployment rate and the area seasonally adjusted labor force is that there exists a negative functional relationship between the unemployment rate and area job opportunities. As the unemployment rate declines, the cause being an increase in job opportunities, the area labor force increases. The labor force variable is treated as the endogenous variable and the unemployment rate as an exogenous variable within this single equation model. Care must be exercised in postulating the cause and effect relationship, for it is apparent that both variables could more realistically be expressed as endogenous variables within a simultaneous equation model.

Another a priori expectation, based on the imperfect nature of an area labor market, is that the dependent variable responds with a significant lag to changes in the independent variables. As for the importance of the individual independent variables, the hypothesis of this investigation is that the area job opportunity variables are relatively more important in the explanation of into- and out-of-the-labor force type of labor mobility than is the job attractiveness variable of the mean wage rate.

Results of the Estimated Regression Equations

Evaluation of the results of experiment one must be conducted in light of the foregoing a priori expectations. A selected set of statistics for all twenty-two labor market areas is presented in Appendix B, Table B-1 and a summary of the significant results is presented in Table V-1. Considering first of all the area wage variable, it can be noted from the estimated data that there is relative independence between variation in the size of the area labor force and variation in the area wage rate. Significance was found between these two variables only in the labor market areas of Washington, D. C., and Salt Lake City. In both cases there did exist a positive

TABLE V-1

SELECTED STATISTICS FROM AN AUTOREGRESSIVE LEAST SQUARES DISTRIBUTED LAG MODEL CONTAINING TWO LAG PARAMETERS IN THE ESTIMATION OF LABOR SUPPLY FUNCTIONS FOR FOURTEEN LABOR MARKET AREAS, 1960 - 1964

Labor Market Area	Regression Coefficients and Calculated Student t Statistics							
	a_0	a_1	b_1	b_2	λ	μ	β	R^2
Washington, District of Columbia	22.741	117.315 (3.07)***	0.148 (1.88)*	11.091 (1.76)*	0.510 (2.29)**	0.678 (2.32)**	-0.070 (0.23)	0.9936
Denver, Colorado	41.292	27.079 (1.37)	0.124 (3.22)***	1.060 (0.56)	0.155 (0.36)	0.838 (12.09)***	-0.224 (0.50)	0.9748
Atlanta, Georgia	52.651	17.389 (0.95)	-0.023 (0.33)	-3.790 (2.48)**	-0.298 (0.33)	0.960 (16.40)***	-0.095 (0.10)	0.9798
Dayton, Ohio	80.524	20.048 (1.33)	0.064 (1.73)*	0.965 (1.02)	0.455 (1.24)	0.213 (0.49)	-0.069 (0.20)	0.9631
Salt Lake City, Utah	-13.954	19.124 (1.96)*	-0.046 (1.18)	1.135 (1.71)	0.827 (10.92)***	-0.649 (3.99)***	0.474 (2.04)*	0.9890
Pittsburgh, Pennsylvania	712.755	-52.129 (1.45)	0.245 (1.00)	4.347 (2.19)**	0.398 (1.25)	0.128 (0.34)	0.220 (0.59)	0.9567
Miami, Florida	144.959	10.165 (0.56)	0.161 (1.64)	4.688 (6.35)***	0.577 (1.88)*	-0.032 (0.22)	0.030 (0.09)	0.8695

TABLE V-1 (continued)

Labor Market Area	Regression Coefficients and Calculated Student t Statistics							
	a_0	a_1	b_1	b_2	λ	μ	β	R^2
Providence-Pawtucket, Rhode Island	80.818	15.994 (0.70)	0.087 (2.05)*	1.431 (0.90)	0.571 (1.42)	0.490 (1.45)	-0.530 (1.90)*	0.8446
Detroit, Michigan	119.049	-89.724 (1.34)	0.338 (1.58)	3.017 (1.73)*	0.463 (0.94)	0.870 (5.36)***	-0.128 (0.27)	0.9315
Philadelphia, Pennsylvania	347.610	8.021 (0.33)	0.355 (2.37)**	10.098 (2.31)**	0.812 (5.19)***	0.126 (0.45)	-0.282 (0.85)	0.8695
Newark, New Jersey	226.546	- 5.901 (0.58)	0.103 (1.40)	10.041 (2.36)**	0.770 (4.53)***	-0.425 (1.72)	0.177 (0.44)	0.6017
Birmingham, Alabama	17.221	3.929 (0.88)	0.007 (0.13)	1.289 (1.79)*	0.895 (5.65)***	0.153 (0.35)	-0.416 (1.06)	0.7781
Seattle, Washington	28.499	- 2.530 (0.12)	0.343 (3.06)***	0.533 (0.43)	0.017 (0.00)	0.865 (15.82)***	0.038 (0.00)	0.9577
New Orleans, Louisiana	76.029	13.339 (1.31)	0.051 (1.01)	-2.039 (1.97)*	0.437 (1.94)*	0.673 (4.37)***	-0.311 (1.16)	0.9860

Notes:

The calculated student t statistic is in parenthesis
- * Significantly different from zero at the .10 level
- ** Significantly different from zero at the .05 level
- *** Significantly different from zero at the .01 level

TABLE V-1 (continued)

Labor Supply Function Estimated:

$$Y_t = a_0 (1 - \lambda)(1 - \mu)(1 - \beta) + a_1 X_{i1t} - (\mu + \beta) a_1 X_{i1t-1} + \mu\beta a_1 X_{i1t-2} + b_1 X_{j1t}$$

$$- (\lambda + \beta) b_1 X_{j1t-1} + \lambda\beta b_1 X_{j1t-2} + b_2 X_{j2t} - (\lambda + \beta) b_2 X_{j2t-1} + \lambda\beta b_2 X_{j2t-2}$$

$$+ (\lambda + \mu + \beta) Y_{t-1} - \left[(\lambda + \mu) \beta + \lambda\mu\right] Y_{t-2} + \lambda\mu\beta Y_{t-3} + e_t$$

Y_t = Seasonally Adjusted Size of Area Labor Force (in thousands)

X_{i1} = Average Hourly Earnings of Production Workers in Manufacturing (dollars per hour)

X_{j1} = Seasonally Adjusted Help-wanted Index (1957 - 1959 = 100)

X_{j2} = Seasonally Adjusted Unemployment Rate (per cent)

λ = Lag Coefficient Associated with Independent Variable(s) X_{it}

μ = Lag Coefficient Associated with Independent Variable(s) X_{jt}

β = First Order Autocorrelation Coefficient

R^2 = Coefficient of Determination

relationship between the wage rate and labor supply variable. It can also be noted that the dependent variable responded with a significant lag to changes in the area wage rate in both of these markets. It, therefore, can be concluded, on the basis of these results, that the area wage rate does not appear to be significant in the explanation of variations in area labor force size.

Variation in the seasonally adjusted help-wanted index was significantly related to variations in the quantity of labor supplied in the six area labor markets of: Washington, D.C., Denver, Dayton, Providence-Pawtucket, Philadelphia, and Seattle. In all six labor markets there existed a positive relationship between changes in the area help-wanted advertising index and changes in the size of the area labor force. This confirms the *a priori* expected relationship between these two variables.

In the nine labor market areas of Washington, D.C., Atlanta, Pittsburgh, Miami, Detroit, Philadelphia, Newark, Birmingham, and New Orleans, the partial regression coefficients of the unemployment rate regressed upon the area size of the labor force were significantly different from zero. In two labor markets the signs of the partial regression coefficients were negative as expected, but in seven labor markets the sign of the coefficients were positive.

In order to resolve the apparent contradiction between the expected relationship of changes in the area unemployment rate in relation to changes in area labor force size, a further analysis was conducted of the sequence of events which might occur which would tend to produce a negative relationship between the two variables over time. The following discussion assumes other factors are held constant except changes in employment and changes in unemployment through time. It is reasonable to assume a negative relationship between the two variables if the following sequences of events occurs. Assume for instance that area job opportunities increase from time period t to time period t + 1. If (a) there is an increase in the number of employed from time period t to time period t + 1 accompanied by a decrease in the number of unemployed from time period t to time period t + 1 or (b) the proportionate increase in the number employed from time period t to time period t + 1 is greater than the proportionate increase in the number of unemployed from time period t to time period t + 1, then a negative relationship would exist between the two variables. Assuming area job opportunities decrease from time period t to time period t + 1 a negative relationship would exist if (a) the decrease in the number of employed from time period t to time period t + 1 is accompanied by an increase in the number of unemployed from time period t to time period t + 1 or (b) if the proportionate decrease in the number of employed from time period t to time period t + 1 is greater than the proportionate decrease in the number of unemployed from time period t to time period t + 1.

There are two other possibilities that deserve attention. In a situation of expanding job opportunities from time period t to time period t + 1, the proportionate increase in the number of employed from time period t to time period t + 1 may be less than the proportionate increase in the number of unemployed from time period t to time period t + 1. This would be the case if many workers entered an area or entered a labor force but did not find jobs. And in a situation of declining job opportunities from time period t to time period t + 1, the proportionate decrease in the number of employed from time period t to time period t + 1 may be less than the proportionate decrease in the number of unemployed from time period t to time period t + 1. This would be the case if the unemployed left the area or left the labor force at a more rapid rate than jobs declined. Assuming other factors constant, if either situation prevails over a series of time periods, there could exist a positive relationship between the area unemployment rate and the size of the area labor force.

In light of the foregoing propositions an explanation for the positive partial regression coefficients (especially for areas such as Pittsburgh, Miami, Detroit, Philadelphia, Newark, and Birmingham which experienced relatively high unemployment rates for the 1960 to 1964 period) may be as follows.

After eliminating from the labor force series simultaneous variation accompanying and therefore assumed due to area wages and the area help-wanted advertising index,[5] the resulting adjusted labor force series tends to vary positively with the area unemployment rate. This is consistent with a shift of individuals from an unemployed status to an out of the labor force status (or vice versa). This could reflect migration out of the market area or discouragement out of the labor

[5] Mordecai Ezekiel and Karl A. Fox, Methods of Correlation and Regression Analysis (third edition; New York: John Wiley & Sons, Inc., 1959), p. 176.

force of unemployed individuals. The following conclusions result from the above relationship. The unemployment rate variable does not appear to be a measure of change in area job opportunities as originally hypothesized. The fact the two variables tend to vary in the same direction may be due to the effect of other variables highly correlated with the unemployment rate and not explicitly accounted for in this regression or may be due to a series of shifts of individuals from the unemployed category to a non-labor force category (or vice versa).

In conducting experiment one, the lag parameter λ was associated with the variable of the area mean wage and the lag parameter μ was associated with the two independent variables of (1) the area help-wanted advertising index and (2) the area seasonally adjusted unemployment rate which were to denote area job opportunities. The lag coefficient λ was positive and significantly different from zero for seven labor markets in Table V-1 which includes Washington, D.C., and Salt Lake City in which the area wage rate was significantly related to the dependent variable. These results indicate a lagged type of adjustment of the size of an area labor force towards its equilibrium with respect to changes in the area wage rate. Of the thirteen different labor markets in which either or both the area help-wanted index and the area unemployment rate were significantly related to changes in area labor force size, the lag coefficient μ was positive and significantly different from zero in six of the labor markets. This first of all indicates for these particular areas that the long run labor force elasticity with respect to job opportunities is greater than the short run elasticity. Three of the areas, Washington, D.C., Denver, and Atlanta, experienced a rapidly growing labor force during this time period and Seattle and Detroit are dominated to some extent by the aircraft and automobile industries respectively. As noted in Chapter IV, one of the reasons for a lag adjustment could be the difficulty of firms locating an individual who possesses the requisite skills to occupy a job vacancy which requires skilled labor. Another possible reason for a significant lag is that in periods in which jobs are being destroyed there is not an immediate corresponding decrease in the labor force through out-migration or dropping out of the labor force because of community ties, i.e., the desire to locate another suitable job in the same community within a short period of time. The results pertaining to the lag coefficient μ correspond favorably with the expected results.

Description of Experiment Two

Functional Relationship

Experiment two was conducted under the assumption the area mean wage had very little affect on area labor force size or possibly that average hourly earnings of production workers in manufacturing may not reasonably represent a measure of movements in the area mean wage. Experiment two was conducted in an effort to determine the differential effects and lags the independent variables of the area help-wanted advertising index and the area seasonally adjusted unemployment rate would exert upon the size of an area labor force. The data covered the five-year period, 1960 to 1964, and the least squares distributed lag model containing two lag parameters developed in Chapter IV was utilized.

This particular regression equation contained two independent variables; the area help-wanted advertising index and the area seasonally adjusted unemployment rate. The lag parameter λ is associated with the former while the lag parameter μ is associated with the latter. The dependent variable is the seasonally adjusted size of the area labor force.

The expected results of experiment two are initially those of experiment one. According to theory there should exist a positive relationship between variation in area job vacancies (area help-wanted advertising index) and variation in area labor supply (size of the area labor force). And if the area unemployment rate is also a measure of area job opportunities, then a negative relationship is expected between it and the area labor force size. Another expectation is that the lag coefficients will be significantly different from zero, signifying an under or over adjustment of the dependent variable to changes in the independent variable.

Results of Estimated Regression Equations

The results of experiment two are similar to those of experiment one and to a significant extent confirm the initial expectations. Complete results for the twenty-two labor market areas are contained in Appendix B, Table B-2, and a summary of the significant results appears in Table V-2.

The job vacancy variable of the help-wanted advertising index was significantly different from zero in nine of the labor market areas. In each of the areas of Denver, Atlanta, Salt Lake City, Miami, Detroit,

TABLE V-2

SELECTED STATISTICS FROM AN AUTOREGRESSIVE LEAST SQUARES DISTRIBUTED LAG MODEL CONTAINING TWO LAG PARAMETERS IN THE ESTIMATION OF LABOR SUPPLY FUNCTIONS FOR FOURTEEN LABOR MARKET AREAS, 1960 - 1964

Labor Market Area	Regression Coefficients and Calculated Student t Statistics						
	a_0	a_1	b_1	λ	μ	β	R^2
Washington, District of Columbia	34.582	0.054 (0.59)	15.970 (2.74)**	0.950 (13.00)***	-0.081 (0.25)	0.208 (0.54)	0.9924
Rochester, New York	46.155	-0.053 (0.54)	-2.809 (1.88)*	-0.145 (0.09)	0.911 (13.14)***	-0.158 (0.10)	0.9721
Denver, Colorado	48.871	0.108 (2.84)***	0.286 (0.13)	0.864 (20.07)***	0.191 (0.47)	-0.256 (0.60)	0.9722
Atlanta, Georgia	58.591	0.165 (2.12)**	-3.700 (3.34)***	-0.421 (1.85)*	0.927 (18.41)***	0.165 (0.51)	0.9827
Salt Lake City, Utah	8.673	0.073 (2.64)**	1.345 (1.87)*	0.915 (32.53)***	-0.611 (3.31)***	0.220 (0.96)	0.9889
Pittsburgh, Pennsylvania	317.974	0.147 (0.60)	4.205 (1.98)*	0.459 (3.44)***	0.500 (3.01)***	-0.424 (1.84)*	0.9494
Miami, Florida	150.723	0.196 (2.68)**	4.781 (6.59)***	0.098 (0.35)	-0.037 (0.27)	0.580 (2.09)**	0.8686

TABLE V-2 (continued)

Labor Market Area	Regression Coefficients and Calculated Student t Statistics						
	a_0	a_1	b_1	λ	μ	β	R^2
Providence-Pawtucket, Rhode Island	68.191	0.073 (1.84)*	1.010 (0.65)	0.769 (6.42)***	0.378 (0.99)	-0.549 (2.00)*	0.8382
Detroit, Michigan	- 1.418	0.132 (3.11)***	5.565 (4.94)***	0.992 (13.85)***	-0.218 (1.13)	0.349 (1.53)	0.9621
Philadelphia, Pennsylvania	368.831	0.333 (2.49)**	2.712 (1.37)	-0.157 (0.41)	0.788 (8.67)***	0.148 (0.33)	0.8584
Newark, New Jersey	122.286	-0.069 (0.87)	8.975 (2.12)**	0.899 (5.87)***	-0.317 (0.84)	-0.059 (0.12)	0.5654
Birmingham, Alabama	32.804	0.032 (1.41)	1.441 (2.20)**	0.873 (6.20)***	0.134 (0.38)	-0.431 (1.40)	0.7939
Seattle, Washington	37.937	0.380 (3.68)***	2.115 (1.51)	0.838 (18.41)***	0.042 (0.06)	-0.008 (0.01)	0.9624
New Orleans, Louisiana	70.603	0.092 (1.73)*	-2.033 (2.32)**	0.372 (1.31)	0.770 (5.01)***	-0.252 (0.88)	0.9852

Notes:

The calculated student t statistic is in parenthesis
* Significantly different from zero at the .10 level
** Significantly different from zero at the .05 level
*** Significantly different from zero at the .01 level

TABLE V-2 (continued)

Labor Supply Function Estimated:

$$Y_t = a_0 (1 - \lambda)(1 - \mu)(1 - \beta) + a_1 X_{i1t} - (\mu + \beta) a_1 X_{i1t-1} + \mu\beta a_1 X_{i1t-2} + b_1 X_{j1t}$$
$$- (\lambda + \beta) b_1 X_{j1t-1} + \lambda\beta b_1 X_{j1t-2} + (\lambda + \mu + \beta) Y_{t-1} - \left[(\lambda + \mu) \beta + \lambda\mu\right] Y_{t-2}$$
$$+ \lambda\mu\beta Y_{t-3} + e_t$$

Y_t = Seasonally Adjusted Size of Area Labor Force (in thousands)

X_{i1} = Seasonally Adjusted Help-wanted Index (1957 - 1959 = 100)

X_{j1} = Seasonally Adjusted Unemployment Rate (per cent)

λ = Lag Coefficient Associated with Independent Variable(s) X_{it}

μ = Lag Coefficient Associated with Independent Variable(s) X_{jt}

β = First Order Autocorrelation Coefficient

R^2 = Coefficient of Determination

Providence-Pawtucket, Philadelphia, Seattle, and New Orleans the relationship was positive. This confirms the expectation that job vacancies within an area would tend to increase the area labor force size. Also of interest in this analysis are the patterns of adjustment of the area labor force size with respect to a change in area job vacancies. The lag coefficient of -0.421 for the Atlanta labor market area is significantly different from zero at the 10 per cent level. This tends to indicate an over adjustment of the labor force to changes in area job vacancies. Such an adjustment path is depicted as the number one dotted line in Figure 4. The number two dotted line depicts a concurrent adjustment path, adjustment occurring within the measured time period utilized in the investigation. This type of adjustment seems to have typified the situation in Miami, Philadelphia, and New Orleans. The mean seasonally adjusted unemployment rates over the five-year period for these areas were 7.17 per cent, 6.50 per cent, and 5.91 per cent respectively. The pressure of relatively substantial unemployment during this period should have aided the adjustment process in that there was an active group of job seekers responding to area job vacancies.

However, for other substantial unemployment areas such as Seattle, Detroit, and Providence-Pawtucket the respective lag coefficients indicate a lagged adjustment path such as the number three dotted line in Figure 4. This type of adjustment also typified the two labor market areas of Denver and Salt Lake City. The following industries are characteristic of the former labor surplus areas: Seattle: aircraft, shipbuilding, and lumber; Detroit: automobiles, household appliances, and tools and dies; Providence-Pawtucket: industrial machinery, jewelry, and a declining textile industry. The latter expanding areas of Denver and Salt Lake City are primarily trade centers for extensive surrounding areas. A lagged adjustment path of the local labor force in response to changes in local job vacancies for these particular areas may be due to time required for in-migration and/or local lack of individuals with needed skills.

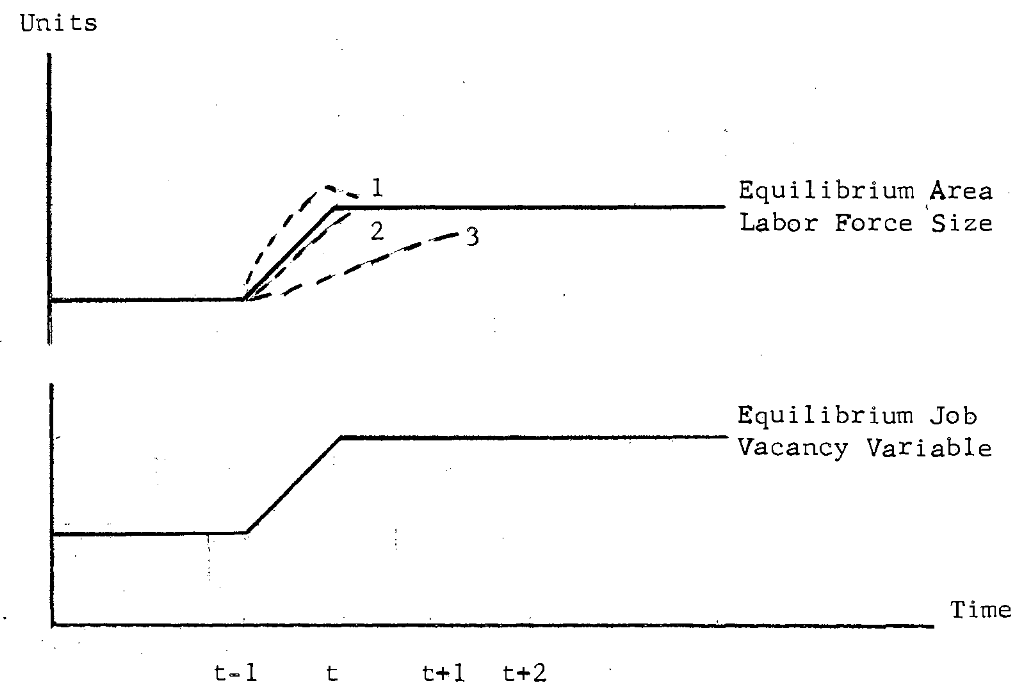

Figure 4. Estimated Adjustment Paths of Actual Area Labor Force Size Towards Equilibrium

Ten of twenty-two area labor markets had a statistically significant relationship between the area unemployment rate independent variable and the area labor force size dependent variable. The relationship was negative in three areas, Rochester, Atlanta, and New Orleans, while it was positive in seven areas, Washington, D.C., Salt Lake City, Pittsburgh, Miami, Detroit, Newark, and Birmingham.

The results were very similar to those reported for experiment one. The negative relationship fits the expectation of the unemployment rate being a proxy for area job opportunities. The positive relationship could be due to a series of shifts of individuals from non-labor force status into the unemployment group or from an unemployment status to a non-labor force status. Migration, of course, may be the underlying factor of the resultant positive relationship.

For the four areas Rochester, Atlanta, New Orleans, and Pittsburgh, the lag coefficient was positive and statistically different from zero. These lag coefficients indicate that actual labor force size proceeded along a lagged adjustment path towards the equilibrium area labor force size with respect to a change in the area unemployment rate. For Salt Lake City the negative lag coefficient is an indication of an over adjustment of the dependent variable towards its equilibrium level with respect to a change in the area unemployment rate. The actual area labor force size of the other areas, Washington, D.C., Miami, Detroit, Newark, and Birmingham, adjusted concurrently towards an approximate new equilibrium level with respect to changes in the respective area unemployment rates. Note that this pattern of concurrent adjustment (with respect to either a change in the area help-wanted advertising index or a change in the area unemployment rate) occurred generally in areas characterized by substantial unemployment during this period.

On the basis of the estimated regression equations, area labor force adjustment (a) proceeded in a positive fashion with respect to changes in area job vacancies and in about half the cases could be described by a distributed lag; (b) reacted both positively and negatively with respect to changes in area unemployment rates and also demonstrated a distributed lag adjustment in about half the cases.

Additional Evidence

The additional evidence presented in this section involving the number of unfilled jobs and their duration is not strictly comparable with the foregoing regression results since the time periods vary. The information presented in this section is for January 1, 1966.

It can be noted from Table 3 that of the three areas evidencing a small proportion of jobs remaining unfilled longer than 30 days, two of them, Atlanta and Miami, had estimated patterns of labor force adjustment characterized as over adjustment or concurrent adjustment. The Miami regressions and the reported figure of 10.7 per cent of total unfilled jobs remaining unfilled in excess of 30 days were undoubtedly influenced by the influx of Cuban refugees during the last five years. On the other hand, the industrialized areas of Seattle, Detroit, and Providence, which experienced a significant lagged labor force adjustment, had proportions of 87.0 per cent, 44.5 per cent, and 55.8 per cent respectively of unfilled job openings which remained unfilled 30 days or longer. The

TABLE V-3

NUMBER OF UNFILLED JOB OPENINGS IN LOCAL PUBLIC EMPLOYMENT OFFICES, JANUARY 1, 1966

Area	Total Number January 1, 1966	Number Unfilled 30 Days or More	Number Unfilled 30 Days or More as a Per Cent of Total
Atlanta, Georgia	1,066	241	22.6
New Orleans, Louisiana	2,372	1,006	42.4
Philadelphia, Pennsylvania	5,004	2,543	50.8
Miami, Florida	1,668	178	10.7
Denver, Colorado	972	176	18.1
Seattle, Washington	8,571	7,457	87.0
Detroit, Michigan	4,991	2,223	44.5
Providence, Rhode Island	2,225	1,242	55.8

Source: U. S. Department of Labor, Bureau of Employment Security, Area Trends in Employment and Unemployment, March, 1966, pp. 49-56.

additional variables of area industry and occupational mixes[6] undoubtedly influence the above proportions and area labor force adjustment; however, it is beyond the scope of the present study to attempt to account for these additional factors.

Labor Supply Elasticities

Introduction

Reference is often made to the elasticity of labor supply in lieu of absolute changes in the quantity of labor supplied. Estimates of the various area short-run and long-run elasticities can be computed by utilizing equations thirteen, fourteen, fifteen and sixteen in Chapter IV. The long-run elasticity of labor supply is generally greater than the corresponding short-run elasticity of labor supply. With a longer period of time available during which the labor supply variable can adjust, labor mobility and consequently labor supply elasticity are greater.

Results of Elasticity Estimates

The results of the estimated labor supply elasticities calculated from the regressions of experiment one are presented in Table V-4 and those calculated from the regressions of experiment two are presented in Table V-5.

First of all, it can be noted that in most labor market areas the labor force was positively elastic in the short-run with respect

---

[6] Wilbur R. Thompson, A Preface to Urban Economics (Resources for the Future, Inc., Baltimore, Maryland: The John Hopkins Press, 1965), pp. 68-70.

TABLE V-4

SELECTED ELASTICITIES OF THE LABOR FORCE COMPUTED FROM THE AUTOREGRESSIVE LEAST SQUARES REGRESSIONS PRESENTED IN TABLE V-1

Labor Market Area	Short-Run Elasticities			Long-Run Elasticities		
	Wages	Help-Wanted Advertising Index	Unemployment Rate	Wages	Help-Wanted Advertising Index	Unemployment Rate
Washington, District of Columbia	.338***	.025*	.029*	.690	.080	.911
Denver, Colorado	.252	.031***	.009	.299	.192	.053
Atlanta, Georgia	.081	-.006	-.029**	.062	-.150	-.718
Dayton, Ohio	.198	.024*	.012	.363	.030	.015
Salt Lake City, Utah	.268*	-.033	.023	1.551	-.020	.014
Pittsburgh, Pennsylvania	-.165	.023	.041**	-.275	.027	.047
Miami, Florida	.046	.034	.077***	.109	.033	.075
Providence-Pawtucket, Rhode Island	.089	.031*	.008	.208	.062	.016

TABLE V-4 (continued)

Labor Market Area	Short-Run Elasticities			Long-Run Elasticities		
	Wages	Help-Wanted Advertising Index	Unemployment Rate	Wages	Help-Wanted Advertising Index	Unemployment Rate
Detroit, Michigan	-.197	.027	.014*	-.367	.208	.110
Philadelphia, Pennsylvania	.011	.020**	.035**	.058	.023	.040
Newark, New Jersey	-.018	.015	.075**	-.078	.010	.052
Birmingham, Alabama	.043	.003	.032*	.406	.004	.037
Seattle, Washington	-.015	.070***	.007	-.015	.521	.049
New Orleans, Louisiana	.094	.013	-.035*	.166	.038	-.106

Notes:

* Significantly different from zero at the .10 level
** Significantly different from zero at the .05 level
*** Significantly different from zero at the .01 level

TABLE V-5

SELECTED ELASTICITIES OF THE LABOR FORCE COMPUTED FROM THE AUTOREGRESSIVE LEAST SQUARES REGRESSIONS PRESENTED IN TABLE V-2

Labor Market Area	Short-Run Elasticities		Long-Run Elasticities	
	Help-Wanted Advertising Index	Unemployment Rate	Help-Wanted Advertising Index	Unemployment Rate
Washington, District of Columbia	.009	.042**	.189	.039
Rochester, New York	-.023	-.034*	-.020	-.379
Denver, Colorado	.027***	.002	.199	.003
Atlanta, Georgia	.043**	-.028***	.030	-.385
Salt Lake City, Utah	.052**	.028*	.610	.017
Pittsburgh, Pennsylvania	.014	.039*	.026	.079
Miami, Florida	.042**	.079***	.047	.076

TABLE V-5 (continued)

Labor Market Area	Short-Run Elasticities		Long-Run Elasticities	
	Help-Wanted Advertising Index	Unemployment Rate	Help-Wanted Advertising Index	Unemployment Rate
Providence-Pawtucket, Rhode Island	.026*	.020	.114	.031
Detroit, Michigan	.011***	.026***	1.383	.022
Philadephia, Pennsylvania	.019**	.009	.016	.044
Newark, New Jersey	-.010	.067**	-.098	.051
Birmingham, Alabama	.014	.035**	.109	.041
Seattle, Washington	.079***	.026	.482	.028
New Orleans, Louisiana	.023*	-.035**	.036	-.150

Notes:

* Significantly different from zero at the .10 level
** Significantly different from zero at the .05 level
*** Significantly different from zero at the .01 level

to changes in the area mean wage rate. Areas in which the labor force was negatively elastic in the short run with respect to changes in the area mean wage were the substantial unemployment areas of Pittsburgh, Detroit, Newark, and Seattle. During the 1960-1964 period these labor market areas experienced average unemployment rates of 8.69 per cent, 6.70 per cent, 6.13 per cent, and 6.04 per cent, respectively. The negative relationship results from the mean wage in these areas increasing over the five-year period in association with decreases in the area labor force after adjusting the area labor force for the effects of the other two independent variables, i.e., the seasonally adjusted help-wanted advertising index and the seasonally adjusted unemployment rate. The short-run labor supply elasticities with respect to area wages tend to be greater for the low unemployment-expanding areas of Washington, D.C., Denver, Atlanta, Dayton, and Salt Lake City than for the other areas. These results indicate that wages may be a more efficient allocative device in areas and periods of expansion than in areas and periods of decline.

There is positive short-run labor force elasticity with respect to the help-wanted advertising index variable in almost all of the labor market areas. In the areas in which there was estimated a negative short-run elasticity the estimate was relatively small. These results compare favorably with the expectations of the job vacancy thesis.

The short-run elasticity of the labor force with respect to the area unemployment rate is positive for most markets while in several it is negative. Possible explanations for this, as stated earlier, are that the area unemployment rate variable is a proxy for a variable other than job opportunities or that there could have been a series of shifts of individuals from the unemployment group to a non-labor force status (or vice versa).

The long-run labor force elasticities generally conformed to theoretical expectations. The long-run elasticities are, in general, equal to or greater than the corresponding short-run elasticities. The longer the time period considered, the greater the mobility and elasticity of the labor force, especially taking into consideration the processes of area out-migration and area in-migration.

Local Labor Market Manpower Policy

Introduction

Since manpower policies are so numerous and range over broad areas such as education, training and retraining, income maintenance, equal opportunity, anti-discrimination, minimum wages, etc., this discussion, by the very nature of the subject, must be selective. In the formulation and implementation of manpower policies there is no substitute for labor market information, specifically information concerning the characteristics of the demand for labor, the characteristics of the supply of labor, and information concerning the amount of labor mobility and the degree of labor utilization.

Recent Legislation

There have been several recent acts of legislation to improve the process of matching the available labor supply to the existing labor demand. For some of the legislation this was the primary purpose while in other cases it was a secondary purpose. The main emphasis, in relation to manpower policy, for such legislation as the Manpower Development and Training Act of 1962 and its amendments of 1963 and 1965, the Trade Expansion Act of 1962, the Vocational Educational Act of 1963, and the Economic Opportunity Act of 1964 is education, training, and retraining. The Public Works and Economic Development Act of 1965 provides funds for assistance in the planning and financing of public works within areas and communities suffering from substantial and persistent unemployment and underemployment. Most of this legislation is designed to aid the country and local communities to make better use of its manpower, to reduce structural unemployment, and to achieve the goal of full employment.

Determination of Labor Needs

There has been a great deal of progress achieved in the direction of identifying labor surpluses and labor surplus areas, primarily as evidenced by area unemployment rates. The unemployment rates reflect a labor supply variable of idle workers. But little has been accomplished in the identification of unfilled labor demand, i.e., the availability of unfilled jobs and the identification of areas experiencing a large proportion of available unfilled jobs relative to the total number of jobs in the area.

The use of indirect measures of unfilled labor demand are difficult to translate into policy significance. For example, the following results can be cited from this study of area labor force responsiveness to unfilled labor demand. The evidence clearly indicates area labor supply is positively elastic with respect to changes in the area help-wanted advertising index. According to experiment one, sixteen of twenty-two labor market areas had estimated positive relationships between the two variables and within six of the labor market areas the relationship was statistically significant. Experiment two depicted a positive relationship between the two variables in fifteen of twenty-two labor market areas and in nine of the fifteen areas the relationship was statistically significant. The help-wanted advertising index is an index constructed from published help-wanted advertisements, adjusted for seasonal fluctuations, of a particular newspaper for each of fifty-two metropolitan areas. Because of the nature of the index, it is impossible to translate the index into approximations of the number of unfilled jobs for the various time periods and areas. Therefore, it is impossible to answer important policy questions relating to acceptable levels of unfilled jobs, whether a particular area is experiencing a structural maladjustment (i.e., high level of unfilled jobs and a high level of unemployment) or whether an area because of rapid expansion (characterized by a high level of unfilled jobs and a low level of unemployment) is experiencing difficulty attracting in-migrants into the area.

For purposes of detailed manpower policy proposals, it is recommended that detailed job vacancy information be relied upon as a direct measure of unfilled jobs, rather than relying upon the few indirect and incomplete measures now available; e.g., the help-wanted advertising index.

> The lack of job vacancy information constitutes the most significant gap in our knowledge of labor market conditions. Statistics on job vacancies would give us a measure of unsatisfied demand for labor which, together with our data on employment, would provide a more complete measure of the demand for labor--something we have never had before.[7]

Job Vacancy Information and Policy Choice

Stigler[8] has pointed out the fact that job information has a cost aspect and a revenue aspect. This is true not only for employers and employees but also for the government. The usefulness of such data, according to Ross,[9] will provide benefits of greater value than the costs of collection. Based on the preceding analysis it seems clear that much of the into- and out-of-labor force movement is functionally related to job vacancies. Improvement in this type of voluntary mobility depends upon improvement in job vacancy labor market information. The usefulness of such data is of equal importance for government policy makers in their direction of existing programs which legislation has already established. For example, training programs are being conducted under the auspices of the Manpower Development and Training Act. The first task which must be accomplished is a determination of what occupational training should be administered so as to improve

---

[7] Arthur M. Ross, "Prepared Statement," in U. S. Congress, Sub-Committee on Economic Statistics of the Joint Economic Committee, Hearings on Job Vacancy Statistics, 89th Congress, 2nd Session, 1966, p. 30.

[8] Stigler, op. cit., pp. 94-105.

[9] Ross, op. cit., pp. 27-37.

an individual's probability of successfully locating a job. Ross states:

> I am confident that data on job vacancies will provide a valuable additional dimension to our system of economic measures and will provide critical insights into the economy. In some cases we will be able to identify what measures should be taken to improve the speed and efficiency of local placement and recruitment mechanisms. In other cases, we will have much clearer indication of the need to achieve a better match between workers and jobs, by such measures as training, counseling, relocation grants, and programs to reduce discrimination. Analysis of labor supply and demand information may point to the need for higher levels of demand.
>
> The analysis of job vacancy data together with other information on the economy will give better clues than have previously been available for the selection and timing of public and private policies.[10]

The need for improvement in speed and efficiency of local placement and recruitment is amply illustrated by the lag coefficients of 0.864, 0.915, 0.769, 0.992, and 0.838 calculated in experiment two for the following respective labor markets: Denver, Salt Lake City, Providence-Pawtucket, Detroit, and Seattle. The respective lag coefficients are those for the estimated adjustment of the local area labor force to a new equilibrium with respect to changes in area job vacancies as measured by the area help-wanted advertising index.

Economic policy considerations could shift emphasis to the aggregate aspects once individual area labor markets become relatively efficient market clearing mechanisms for existing unfilled jobs. One important aggregate consideration is to

---

[10] Ibid., p. 31.

attempt to insure a level of spending, which is the means toward job creation, necessary to achieve the desired unemployment goal.

Conclusion

The traditional recommendations for improving labor mobility are to improve the over-all performance of the United States Employment Service, to improve the interarea recruitment system of the United States Employment Service, to provide either loan or grant funds for relocation assistance, to adapt private pension plans to allow workers to change jobs while retaining some benefits in the pension system, and to improve education and training in general. All of the recommendations, to some extent, could be of increased importance if they were based upon more reliable job vacancy information. Job vacancy information could provide the basis for increasing the effectiveness of manpower policy legislation, increasing the effectiveness of private decisions and individual voluntary mobility with respect to participation in the labor force, and increasing the effectiveness of the public manpower decision making process in the future.

CHAPTER VI

SUMMARY AND CONCLUSIONS

Summary

One of the main objectives of this investigation is to study labor force flexibility over time within the context of major local labor market areas. The study is specifically restricted to into- and out-of-the-labor force type of mobility. If the supply of labor is defined in terms of the number of individuals comprising the area labor force, then this investigation is in essence a study of the supply function of labor for various labor market areas. Specifically, the specification and estimation of various area labor supply functions is performed in order to evaluate various hypotheses. Can variation in the size of the area labor force over time be explained by variation in variables representing area job attractiveness and area job vacancies? Is variation in the area job vacancy variable relatively more important than variation in the area job attractiveness variable in relation to the explanation of variation in area labor force size over time? Is a distributed lag regression model applicable to the study of area labor force adjustment over time?

The review of the literature concentrated on two principal types of investigations, those characterized as migration studies and those characterized as labor force participation rate studies. These studies indicate that, among other variables, wages, job vacancies, and the unemployment rate are important independent variables in the explanation of variation in migration and variation in labor force participation. This study deals with the same variables, but attempts to go beyond previous studies by using different econometric methods. None of the other studies are directed at a time series analysis of labor force behavior within major local labor market areas nor did any of the other studies specifically attempt to investigate labor force behavior within the framework of a dynamic econometric model, such as a distributed lag regression model.

Labor market theory distinguished between the effects of in-migration and increased labor force participation. Job vacancy information is one of the important mechanisms employers are apt to use to attract employees and to which employees are responsive, even if employees explicitly consider the marginal costs and marginal returns of job search. Therefore in the static and dynamic specifications of an area labor supply function, it is necessary to include both area wages and area job vacancies as independent variables.

Conclusions

It is quite evident from the autoregressive least squares regression analysis of the twenty-two labor market areas that the job vacancy variable of the area help-wanted advertising index is a relatively more important variable than the area mean wage in the explanation of the adjustment process of an area labor force to its equilibrium level. The area unemployment rate does not appear to be a proxy variable measuring changes in area job opportunities. However, the positive relationship estimated in most labor market areas between variation in area labor force size and variation in both independent variables of the area mean wage and the area help-wanted advertising index do confirm a priori expectations.

The autoregressive least squares distributed lag model containing two lag parameters is not only applicable to this type of investigation but it also provides information concerning the dynamic adjustment process of the area labor force which is not available from an ordinary least squares regression model. Reference to the coefficients of determination in Tables B-1 and B-2 of Appendix B provide evidence that, for a majority of cases, this particular model and selection of independent variables explain more than ninety-five per cent of the variation in the dependent variable. The estimates of the two lag parameters were, in general, between zero and plus one and significantly different from zero as confirmed by the large calculated student t statistics associated with the estimates. This information confirms the expectation of significant lags existing in the adjustment of the area labor force towards its equilibrium level. It confirms that this adjustment can be described as a distributed lag adjustment as it is spread over several time periods. It also signifies that long-run elasticities with respect to each of the independent variables are greater than the corresponding short-run elasticities. Table V-4 and V-5 present the estimated long-run and short-run labor force elasticities illustrating the above conclusions.

The role of current governmental manpower policy in the adaptation of local labor supply to local labor demands is at present concentrated on training, retraining, and vocational education. Effort has only recently been expanded in the direction of achieving more reliable area labor demand information, i.e., experimental job vacancy surveys within sixteen metropolitan areas and also in establishing an experimental relocation assistance program. The availability of more adequate statistical data concerning area job vacancies and their related attributes of wage rates offered, occupations involved, industries concerned, etc. will improve individual voluntary mobility and allow government policy makers to improve their manpower policy choices.

Suggestions for Further Study

It can be determined from Table V-1, Table V-2, and the Appendix tables B-1 and B-2 that in several of the regression equations a particular regression coefficient may not have been significant while its associated lag coefficient was significant. This may be an indication that the specified functional form is inappropriate, or the first order autocorrelation assumption of the residual error term may be inappropriate, or to a degree, both of these factors may be inappropriate. Therefore in the future investigation of the effects of job vacancies and unemployment on labor force size, it is suggested that other functional forms be specified and estimated. Also other autocorrelation schemes of the residual error term could be attempted. In addition, recent pilot studies have attempted direct measurement of the number of job vacancies in each of several major labor market areas. Therefore in the future, the direct measurement of job vacancies may well provide a more reliable basis for assessing the impact of the unsatisfied demand for labor upon area labor force size.

A SELECTED BIBLIOGRAPHY

Bakke, E. Wight. A Positive Labor Market Policy. Columbus, Ohio: Charles E. Merrill Books, Inc., 1963.

Bakke, E. Wight, Hauser, Philip M., Palmer, Gladys L., Myers, Charles A., Yoder, Dale, and Kerr, Clark. Labor Mobility and Economic Opportunity. The Technology Press of Massachusetts Institute of Technology and New York: John Wiley & Sons, Inc., 1954.

Bancroft, Gertrude. The American Labor Force: Its Growth and Changing Composition. Social Science Research Council, New York: John Wiley & Sons, Inc., 1958.

Blanco, Cicely. "The Determinants of Interstate Population Movements," Journal of Regional Science, V (Summer, 1963), 77-84.

Bloom, Gordon F., and Northrup, Herbert R. Economics of Labor Relations. Homewood, Illinois: Richard D. Irwin, Inc., 1958.

Bowen, William G. The Wage-Price Issue A Theoretical Analysis. Princeton: Princeton University Press, 1960.

Bowen, William G., and Finegan, T. A. "Labor Force Participation and Unemployment," in Arthur M. Ross (ed.), Employment Policy and the Labor Market, (Berkeley: University of California Press, 1965), 115-61.

Bowen, William G., and Finegan, T. A. "Discussion," in Robert A. Gordon and Margaret S. Gordon (ed.) Prosperity and Unemployment, (New York: John Wiley & Sons, Inc., 1966), 113-121.

Bunting, Robert L. "A Test of the Theory of Geographic Mobility," Industrial and Labor Relations Review, XV (October, 1961), 75-82.

Dernburg, Thomas, and Strand, Kenneth. "Hidden Unemployment 1953-1962: A Quantitative Analysis by Age and Sex," The American Economic Review, LVI (March, 1966), 71-95.

Dow, J. C. R., and Dicks-Mireaux, L. A. "The Excess Demand for Labour A Study of Conditions in Great Britain, 1946-56," Oxford Economic Papers, X (February, 1958), 1-33.

Duesenberry, James S. Business Cycles and Economic Growth. New York: McGraw-Hill Book Company, Inc., 1958.

Ezekiel, Mordecai, and Fox, Karl A. Methods of Correlation and Regression Analysis. Third Edition. New York: John Wiley & Sons, Inc., 1959.

Fuller, Wayne A., and Martin, James E. "The Effects of Autocorrelated Errors on the Statistical Estimation of Distributed Lag Models," Journal of Farm Economics, XLIII, No. 1 (February, 1961), 71-82.

Fuller, Wayne A., and Martin, James E. "A Note on the Effects of Autocorrelated Errors on the Statistical Estimation of Distributed Lag Models," Journal of Farm Economics, XLIV, No. 2 (May, 1962), 407-10.

Gallaway, Lowell E. "Labor Mobility, Resource Allocation, and Structural Unemployment," The American Economic Review, LIII (September, 1963), 694-716.

Gitlow, Abraham L. Labor and Industrial Society. Revised Edition. Homewood, Illinois: Richard D. Irwin, Inc., 1963.

Hansen, W. Lee. "The Cyclical Sensitivity of the Labor Supply," The American Economic Review, LI (June, 1961), 299-309.

Hartley, H. O. "The Modified Gauss-Newton Method for the Fitting of Non-Linear Regression Functions by Least Squares," Technometrics, III, No. 2 (May, 1961), 269-80.

Heller, Walter W. "Employment and Manpower," in Stanley Lebergott (ed.), Men Without Work The Economics of Unemployment, (Englewood Cliffs, New Jersey: Prentice-Hall, Inc., 1964), 68-93.

Hicks, J. R. The Theory of Wages, Second Edition. New York: St. Martin's Press, 1963.

Koyck, L. M. Distributed Lags and Investment Analysis. Amsterdam: North-Holland Publishing Company, 1954.

Leftwich, Richard H. The Price System and Resource Allocation. Third Edition. New York: Holt, Rinehart and Winston, 1966.

Levine, Louis. "Unemployment by Locality and Industry," in The Measurement and Behavior of Unemployment, National Bureau of Economic Research (Princeton: Princeton University Press, 1957), 325-80.

Liebhafsky, H. H. The Nature of Price Theory. Homewood, Illinois: The Dorsey Press, Inc., 1963.

Lipsey, Richard G. "The Relation Between Unemployment and the Rate of Change of Money Wage Rates in the United Kingdom, 1862-1957: A Further Analysis," Economica, XXVII (February, 1960), 1-31.

Martin, James E. "An Application of Distributed Lags in Short-run Consumer Demand Analysis." Unpublished Ph.D. dissertation, Iowa State University, 1962.

Martin, James E. "Computer Programs For Estimating Certain Classes of Non-linear Distributed Lag Models." Misc. Publication No. 546, Department of Agricultural Economics, University of Maryland (May, 1965), 1-28.

Martin, James E. "The Use of Distributed Lag Models Containing Two Lag Parameters in the Estimation of Elasticities of Demand," Journal of Farm Economics, XLV, No. 5 (December, 1963), 1474-1481.

Mincer, Jacob. "Labor-Force Participation and Unemployment A Review of Recent Evidence," in Robert A. Gordon and Margaret S. Gordon (ed.), Prosperity and Unemployment, (New York: John Wiley & Sons, Inc., 1966), 73-112.

Myers, Charles A. "Labour Market Theory and Empirical Research," in The Theory of Wage Determination. London: Macmillan & Co., Ltd., 1957. 317-26.

National Industrial Conference Board, Inc. New Index of Help-wanted Advertising. Technical Paper Number Sixteen. New York: National Industrial Conference Board, Inc., 1964.

Nerlove, Marc. Distributed Lags and Demand Analysis for Agricultural and Other Commodities. Agriculture Handbook No. 141, Washington, D. C.: United States Department of Agriculture, 1958.

Nerlove, Marc, and Addison, William. "Statistical Estimation of Long-run Elasticities of Supply and Demand," Journal of Farm Economics, XL, No. 4 (November, 1958), 861-80.

Parnes, Herbert S. Research on Labor Mobility An Appraisal of Research Findings in the United States. Bulletin 65. New York: Social Science Research Council, 1954.

President's Committee to Appraise Employment and Unemployment Statistics. Measuring Employment and Unemployment. Washington: U. S. Government Printing Office, 1962.

Raimon, Robert L. "Interstate Migration and Wage Theory," The Review of Economics and Statistics, XLIV (November, 1962), 428-38.

Raimon, Robert L. "Labor Mobility and Wage Inflexibility," Proceedings of Sixteenth Annual Meeting of Industrial Relations Research Association, No. 32 (December, 1963), 116-129.

Reder, M. W. "Wage Structure and Structural Unemployment," Review of Economic Studies, XXXI (October, 1964), 309-22.

Rees, Albert. "Information Networks in Labor Markets," The American Economic Review, LVI (May, 1966), 559-66.

Reynolds, Lloyd G. The Structure of Labor Markets. New York: Harper & Brothers, 1951.

Ross, Arthur M. "Prepared Statement," in U. S. Congress, Subcommittee on Economic Statistics of the Joint Economic Committee, Hearings on Job Vacancy Statistics. 89th Congress, 2nd Session, 1966, 27-37.

Singell, Larry D. "Some Private and Social Aspects of the Labor Mobility of Young Workers," The Quarterly Review of Economics and Business, VI, No. 1 (Spring, 1966), 19-27.

Stigler, George J. "The Economics of Information," The Journal of Political Economy, LXIX (June, 1961), 213-25.

Stigler, George J. "Information in the Labor Market," The Journal of Political Economy, LXX Supplement (October, 1962), 94-105.

Strand, Kenneth, and Dernburg, Thomas. "Cyclical Variation in Civilian Labor Force Participation," Review of Economics and Statistics, XLVI (November, 1964), 378-91.

Tella, Alfred. "The Relation of Labor Force to Employment," Industrial and Labor Relations Review, XVII (April, 1964), 454-69.

Tella, Alfred. "Labor Force Sensitivity to Employment by Age, Sex," Industrial Relations, IV (February, 1965), 69-83.

Thompson, Wilbur R. A Preface to Urban Economics. Resources for the Future, Inc. Baltimore, Maryland: The John Hopkins Press, 1965.

Ulman, Lloyd. "Labor Mobility and the Industrial Wage Structure in the Postwar United States," The Quarterly Journal of Economics, LXXIX (February, 1965), 73-97.

U. S. Congress, Subcommittee on Economic Statistics of the Joint Economic Committee. Hearings on Job Vacancy Statistics. 89th Congress, 2nd Session, May 17-18, 1966.

U. S. Congress, Subcommittee on Employment and Manpower and Select Subcommittee on Labor. Joint Hearings on 1965 Manpower Report of the President. 89th Congress, 1st Session, April, 1965.

U. S. Department of Labor, Bureau of Employment Security. Area Trends in Employment and Unemployment, 1962-1966.

U. S. Department of Labor, Bureau of Employment Security, The Labor Market and Employment Security, 1960-1963.

U. S. Department of Labor, Bureau of Labor Statistics. Employment and Earnings, 1960-1966.

U. S. House of Representatives, Committee on Public Works. Hearings on Public Works and Economic Development Act of 1965. 89th Congress, 1st Session, May, 1965.

U. S. Senate, Committee on Public Works. Hearings on Public Works and Economic Development Act of 1965. 89th Congress, 1st Session, April, 1965.

Wilcock, Richard C. "The Secondary Labor Force and the Measurement of Unemployment," in The Measurement and Behavior of Unemployment, National Bureau of Economic Research (Princeton: Princeton University Press, 1957), 167-210.

APPENDIX A

AREA AVERAGE HOURLY EARNINGS OF PRODUCTION WORKERS IN MANUFACTURING, AREA SEASONALLY ADJUSTED HELP WANTED INDEX, AREA SEASONALLY ADJUSTED UNEMPLOYMENT RATE, AND AREA SEASONALLY ADJUSTED SIZE OF THE LABOR FORCE, BIMONTHLY, 1960-1964, FOR SAMPLE OF TWENTY-TWO MAJOR LABOR MARKET AREAS

The data utilized to investigate the regression relationship between the dependent variable of the seasonally adjusted size of an area labor force and the independent variables of area wages, area help-wanted advertising index, and the area unemployment rate were obtained from the following sources. Average hourly earnings of production workers in manufacturing was used as the measure of an index of the mean area wage rate. Its source was the U. S. Department of Labor, Bureau of Labor Statistics, Employment and Earnings, 1960-1966. The seasonally adjusted index of help-wanted advertising was used as a measure of area job vacancies and was located in: National Industrial Conference Board, Inc., New Index of Help-wanted Advertising, Technical Paper Number Sixteen, New York: National Industrial Conference Board, Inc., 1964. The size of an area labor force and the number of unemployed for each area were adjusted for seasonal variation by the use of the ratio-to-moving average method. Both series of data were located in the two following sources: (a) U. S. Department of Labor, Bureau of Employment Security, Area Trends in Employment and Unemployment, 1962-1966; (b) U. S. Department of Labor, Bureau of Employment Security, The Labor Market and Employment Security, 1960-1963.

Average hourly earnings for production workers in manufacturing were obtained from establishment data. The earnings figures were collected and reported for the pay period which most nearly coincides with the standard survey reference week. Average hourly earnings measure the average actual return per hour to a worker. Because of the exclusion of various welfare benefits, employer payroll taxes, etc., they are not identical with wage rates. Since the establishment data covers approximately sixty-five per cent of total employment in the manufacturing sector the resulting average is a representative estimate.

The index of help-wanted advertising was based on the number of help-wanted advertising published in the classified section of leading metropolitan newspapers. The original data was then adjusted for the monthly variation in the number of Sundays and for seasonal variation. After these two adjustments the average daily help-wanted advertisement volume was converted to an index for each city with a base of 1957-1959 average daily volume equal to 100. The index was not representative of the number of job vacancies within an area to the extent that the index is based upon the number of help-wanted advertisements rather than the number of job vacancies listed in the advertisements; to the extent that a portion of the number of help-wanted advertisements are actually for job vacancies in other areas; and to the extent that other modes of recruitment are used.

The unadjusted labor force and unemployment estimates for major labor market areas are primarily developed by the State employment security agencies in cooperation with the Bureau of Employment Security and the Bureau of Labor Statistics. Both series of figures were adjusted for seasonal variation by the use of the ratio-to-moving average method. The seasonally adjusted labor force series were the figures used as the dependent variable. The ratio of the seasonally adjusted unemployment series to the seasonally adjusted labor force series provided the estimates of the series of area seasonally adjusted unemployment rates utilized as an independent variable. These estimates appeared to be relatively representative in that similar seasonal patterns emerge from year to year for a particular area.

TABLE A-1

WASHINGTON, DISTRICT OF COLUMBIA

Time Period		Average Hourly Earnings of Production Workers in Manufacturing (dollars per hour)	Seasonally Adjusted Help-Wanted Index (1957-1959=100)	Seasonally Adjusted Unemployment Rate (per cent)	Seasonally Adjusted Size of Labor Force (thousands)
1960	January	2.43	131	2.35	849.4
	March	2.43	125	2.56	845.8
	May	2.48	121	2.41	850.1
	July	2.49	110	2.02	846.1
	September	2.53	113	2.52	856.8
	November	2.56	105	2.61	865.5
1961	January	2.51	109	2.60	864.3
	March	2.55	117	2.81	874.9
	May	2.55	119	2.73	872.8
	July	2.54	125	2.76	878.2
	September	2.56	140	2.65	883.5
	November	2.57	159	2.49	893.6
1962	January	2.60	152	2.53	901.3
	March	2.58	145	2.54	903.7
	May	2.59	156	2.31	910.6
	July	2.62	162	2.46	919.5
	September	2.66	150	2.34	926.4
	November	2.67	154	2.30	929.0
1963	January	2.69	167	2.41	945.2
	March	2.71	170	2.44	951.5
	May	2.78	166	2.49	962.1
	July	2.82	177	2.53	974.8
	September	2.79	185	2.39	973.3
	November	2.82	184	2.42	973.4
1964	January	2.82	206	2.28	974.0
	March	2.82	210	2.11	978.3
	May	2.83	207	2.33	985.6
	July	2.82	223	2.44	989.0
	September	2.86	236	2.40	988.9
	November	2.87	231	2.30	990.6

TABLE A-2

RICHMOND, VIRGINIA

Time Period		Average Hourly Earnings of Production Workers in Manufacturing (dollars per hour)	Seasonally Adjusted Help-Wanted Index (1957-1959= 100)	Seasonally Adjusted Unemploy-ment Rate (per cent)	Seasonally Adjusted Size of Labor Force (thousands)
1960	January	1.94	94	2.63	199.8
	March	1.95	94	3.02	196.3
	May	1.97	96	3.18	197.9
	July	2.01	92	2.93	200.4
	September	2.03	88	3.28	201.0
	November	2.03	88	3.12	201.5
1961	January	2.02	88	3.23	201.6
	March	2.01	85	3.93	202.9
	May	2.04	85	3.73	201.5
	July	2.06	93	3.17	202.8
	September	2.05	96	2.97	202.7
	November	2.10	111	2.87	203.5
1962	January	2.10	118	2.53	204.2
	March	2.11	128	2.38	204.8
	May	2.14	118	2.30	206.5
	July	2.14	98	2.27	207.1
	September	2.14	101	2.27	207.3
	November	2.16	103	2.38	208.4
1963	January	2.14	114	2.39	208.3
	March	2.17	124	2.24	209.2
	May	2.18	109	2.15	210.6
	July	2.18	99	2.18	211.1
	September	2.19	107	2.27	212.8
	November	2.24	115	2.22	213.6
1964	January	2.20	132	2.26	215.9
	March	2.21	146	2.01	216.0
	May	2.23	146	2.19	217.5
	July	2.27	146	2.45	217.9
	September	2.22	153	2.31	219.1
	November	2.30	173	2.04	220.9

TABLE A-3

ROCHESTER, NEW YORK

Time Period		Average Hourly Earnings of Production Workers in Manufacturing (dollars per hour)	Seasonally Adjusted Help-Wanted Index (1957-1959=100)	Seasonally Adjusted Unemployment Rate (per cent)	Seasonally Adjusted Size of Labor Force (thousands)
1960	January	2.45	120	3.33	249.6
	March	2.45	113	3.81	252.0
	May	2.45	117	3.99	251.0
	July	2.52	112	3.83	251.8
	September	2.52	104	3.75	253.3
	November	2.50	98	3.90	256.6
1961	January	2.55	91	4.34	255.7
	March	2.54	89	4.33	255.4
	May	2.55	89	4.45	252.7
	July	2.58	94	3.99	253.7
	September	2.58	99	3.92	255.6
	November	2.59	101	3.56	258.6
1962	January	2.63	110	3.29	256.0
	March	2.65	115	3.21	258.1
	May	2.67	117	3.13	265.7
	July	2.66	113	3.10	267.1
	September	2.65	114	3.00	268.4
	November	2.66	112	3.08	264.9
1963	January	2.69	110	3.09	272.5
	March	2.70	116	3.06	275.5
	May	2.74	108	3.02	275.4
	July	2.79	110	3.06	277.6
	September	2.80	109	3.13	278.3
	November	2.78	122	2.99	280.8
1964	January	2.83	125	2.69	282.6
	March	2.84	135	2.54	283.8
	May	2.85	137	2.45	285.0
	July	2.85	140	2.28	287.5
	September	2.86	152	2.06	288.4
	November	2.86	155	1.81	291.5

TABLE A-4

DENVER, COLORADO

Time Period		Average Hourly Earnings of Production Workers in Manufacturing (dollars per hour)	Seasonally Adjusted Help-Wanted Index (1957-1959=100)	Seasonally Adjusted Unemployment Rate (per cent)	Seasonally Adjusted Size of Labor Force (thousands)
1960	January	2.39	134	3.09	391.6
	March	2.40	131	3.17	391.2
	May	2.41	126	3.21	392.7
	July	2.43	113	3.19	398.0
	September	2.45	115	3.10	403.4
	November	2.46	113	3.40	408.9
1961	January	2.48	110	3.33	417.3
	March	2.50	114	3.61	419.6
	May	2.54	110	3.44	421.0
	July	2.57	108	3.25	426.3
	September	2.58	116	3.43	429.6
	November	2.59	122	3.37	429.8
1962	January	2.60	123	3.43	435.8
	March	2.62	125	3.07	437.9
	May	2.65	109	3.44	441.0
	July	2.65	114	3.48	443.2
	September	2.63	108	3.56	440.6
	November	2.63	107	3.80	440.0
1963	January	2.63	93	3.90	436.4
	March	2.69	124	4.02	439.4
	May	2.67	99	3.82	436.8
	July	2.69	88	3.96	437.7
	September	2.74	83	3.79	438.5
	November	2.78	104	3.33	438.2
1964	January	2.75	105	3.21	438.0
	March	2.78	105	3.19	437.3
	May	2.79	115	3.18	440.4
	July	2.80	96	3.26	435.3
	September	2.80	77	3.22	432.3
	November	2.78	121	3.62	435.4

TABLE A-5

OMAHA, NEBRASKA

Time Period		Average Hourly Earnings of Production Workers in Manufacturing (dollars per hour)	Seasonally Adjusted Help-Wanted Index (1957-1959=100)	Seasonally Adjusted Unemployment Rate (per cent)	Seasonally Adjusted Size of Labor Force (thousands)
1960	January	2.27	130	2.81	191.9
	March	2.19	120	3.30	191.2
	May	2.22	133	3.02	191.3
	July	2.26	127	3.20	192.6
	September	2.27	120	3.47	193.7
	November	2.27	118	3.77	195.3
1961	January	2.30	105	3.51	198.1
	March	2.30	106	3.64	198.4
	May	2.34	99	4.10	199.1
	July	2.36	106	3.83	199.0
	September	2.37	108	3.92	199.1
	November	2.37	113	3.89	200.5
1962	January	2.40	115	3.73	197.1
	March	2.35	116	3.71	199.0
	May	2.40	114	3.46	201.6
	July	2.41	110	3.72	202.3
	September	2.43	104	3.51	202.0
	November	2.50	108	3.56	198.5
1963	January	2.48	101	3.82	201.2
	March	2.48	114	3.72	200.9
	May	2.50	91	3.61	199.7
	July	2.50	101	3.64	200.6
	September	2.52	85	3.53	200.6
	November	2.59	101	3.22	202.8
1964	January	2.59	102	3.40	202.2
	March	2.57	110	3.37	201.8
	May	2.58	95	3.23	201.0
	July	2.59	105	3.11	201.0
	September	2.62	97	3.04	201.0
	November	2.66	112	2.80	202.9

TABLE A-6

JACKSONVILLE, FLORIDA

Time Period		Average Hourly Earnings of Production Workers in Manufacturing (dollars per hour)	Seasonally Adjusted Help-Wanted Index (1957-1959=100)	Seasonally Adjusted Unemployment Rate (per cent)	Seasonally Adjusted Size of Labor Force (thousands)
1960	January	2.01	117	2.96	179.2
	March	2.00	111	3.23	175.4
	May	2.03	104	3.23	179.3
	July	2.02	99	3.91	181.1
	September	2.03	97	3.76	181.2
	November	1.99	99	3.98	182.4
1961	January	1.99	87	4.11	188.8
	March	2.00	91	4.50	189.7
	May	2.03	87	4.95	187.8
	July	2.10	86	4.42	187.4
	September	2.10	93	4.56	188.4
	November	2.07	100	3.77	187.1
1962	January	2.08	101	3.80	184.9
	March	2.05	101	3.62	184.5
	May	2.12	103	3.30	185.6
	July	2.13	104	3.22	185.7
	September	2.09	97	3.26	184.7
	November	2.10	92	3.65	184.7
1963	January	2.09	97	3.83	181.2
	March	2.14	107	3.75	181.0
	May	2.19	107	3.62	181.9
	July	2.17	111	3.53	182.2
	September	2.16	118	3.33	181.2
	November	2.20	121	3.30	182.3
1964	January	2.19	114	2.91	181.9
	March	2.20	119	2.60	181.8
	May	2.23	134	2.49	182.0
	July	2.24	122	2.43	181.2
	September	2.29	112	2.50	183.0
	November	2.27	134	2.57	185.3

TABLE A-7

ATLANTA, GEORGIA

Time Period		Average Hourly Earnings of Production Workers in Manufacturing (dollars per hour)	Seasonally Adjusted Help-Wanted Index (1957-1959=100)	Seasonally Adjusted Unemployment Rate (per cent)	Seasonally Adjusted Size of Labor Force (thousands)
1960	January	2.07	119	3.76	455.5
	March	2.04	109	3.84	445.8
	May	2.06	103	3.87	455.8
	July	2.04	102	4.10	452.6
	September	2.11	86	4.34	454.8
	November	2.05	73	4.66	458.2
1961	January	2.07	83	4.65	460.0
	March	2.05	90	5.31	460.6
	May	2.09	91	5.55	449.6
	July	2.09	101	4.93	453.6
	September	2.05	100	4.94	450.5
	November	2.18	108	4.21	454.8
1962	January	2.22	119	4.07	458.4
	March	2.18	119	3.73	458.0
	May	2.22	128	3.51	464.2
	July	2.22	123	3.45	466.2
	September	2.24	118	3.16	470.2
	November	2.25	125	3.31	467.4
1963	January	2.21	130	3.09	477.4
	March	2.17	133	3.01	481.7
	May	2.27	138	2.98	491.2
	July	2.27	138	2.99	494.7
	September	2.32	150	2.93	499.8
	November	2.42	160	2.87	504.7
1964	January	2.38	142	2.99	497.8
	March	2.37	152	2.68	503.4
	May	2.35	163	2.52	510.5
	July	2.38	150	2.62	514.6
	September	2.43	162	2.58	521.4
	November	2.45	178	2.71	527.4

TABLE A-8

COLUMBUS, OHIO

Time Period		Average Hourly Earnings of Production Workers in Manufacturing (dollars per hour)	Seasonally Adjusted Help-Wanted Index (1957-1959=100)	Seasonally Adjusted Unemployment Rate (per cent)	Seasonally Adjusted Size of Labor Force (thousands)
1960	January	2.48	125	3.54	296.0
	March	2.45	118	3.70	295.8
	May	2.46	113	3.53	302.6
	July	2.46	102	4.10	300.6
	September	2.48	101	4.38	303.5
	November	2.47	98	4.61	302.2
1961	January	2.50	96	4.48	306.6
	March	2.51	108	4.80	310.6
	May	2.50	102	4.92	307.6
	July	2.55	119	4.31	310.2
	September	2.53	118	3.82	310.5
	November	2.61	131	3.55	311.9
1962	January	2.60	142	3.44	311.9
	March	2.60	141	3.43	313.9
	May	2.60	142	3.30	316.6
	July	2.61	136	3.29	317.7
	September	2.61	130	3.53	315.2
	November	2.63	146	3.55	317.5
1963	January	2.65	147	3.59	316.7
	March	2.66	136	3.61	315.3
	May	2.67	137	3.40	317.8
	July	2.68	144	3.35	318.4
	September	2.70	146	3.35	321.2
	November	2.75	175	3.27	323.3
1964	January	2.74	172	3.35	323.1
	March	2.75	185	2.99	322.1
	May	2.76	160	3.12	323.4
	July	2.75	165	3.30	323.2
	September	2.77	165	3.44	323.6
	November	2.80	217	3.21	326.2

TABLE A-9

OKLAHOMA CITY, OKLAHOMA

Time Period		Average Hourly Earnings of Production Workers in Manufacturing (dollars per hour)	Seasonally Adjusted Help-Wanted Index (1957-1959=100)	Seasonally Adjusted Unemployment Rate (per cent)	Seasonally Adjusted Size of Labor Force (thousands)
1960	January	1.98	131	3.46	211.8
	March	1.96	119	3.97	212.8
	May	1.99	129	3.36	212.6
	July	1.96	120	3.54	213.9
	September	1.98	115	3.66	214.6
	November	1.98	118	3.94	216.2
1961	January	1.99	98	4.05	218.2
	March	2.01	92	4.60	219.4
	May	2.00	114	4.66	220.4
	July	2.01	98	4.37	221.7
	September	2.04	102	4.25	221.6
	November	2.06	106	4.00	223.1
1962	January	2.07	135	3.85	224.5
	March	2.07	144	3.60	226.6
	May	2.07	128	3.52	228.7
	July	2.07	122	3.55	229.5
	September	2.09	114	3.64	231.1
	November	2.11	138	3.41	232.1
1963	January	2.12	146	3.50	232.4
	March	2.12	136	3.45	233.6
	May	2.10	134	3.40	236.2
	July	2.13	139	3.43	237.8
	September	2.15	139	3.41	240.3
	November	2.18	156	3.49	240.9
1964	January	2.18	166	3.43	242.2
	March	2.18	153	3.24	242.6
	May	2.20	149	3.27	242.1
	July	2.21	154	3.51	243.5
	September	2.21	155	3.53	244.8
	November	2.26	167	3.59	245.6

TABLE A-10

DAYTON, OHIO

Time Period		Average Hourly Earnings of Production Workers in Manufacturing (dollars per hour)	Seasonally Adjusted Help-Wanted Index (1957-1959=100)	Seasonally Adjusted Unemployment Rate (per cent)	Seasonally Adjusted Size of Labor Force (thousands)
1960	January	2.70	135	3.10	286.9
	March	2.71	123	3.25	286.0
	May	2.71	104	3.78	291.8
	July	2.73	98	4.13	290.4
	September	2.77	93	4.41	289.8
	November	2.77	83	4.79	291.1
1961	January	2.80	81	4.81	293.8
	March	2.78	78	5.30	292.6
	May	2.81	87	5.66	292.0
	July	2.84	89	4.83	291.8
	September	2.84	93	4.69	293.0
	November	2.87	104	4.11	293.7
1962	January	2.88	105	3.87	292.7
	March	2.87	109	3.77	294.7
	May	2.90	112	3.80	296.2
	July	2.89	110	3.62	295.9
	September	2.94	110	3.57	296.1
	November	2.94	106	3.58	296.6
1963	January	2.94	103	3.64	295.3
	March	2.97	107	3.45	295.8
	May	2.98	110	3.28	297.3
	July	3.01	112	3.31	298.2
	September	3.04	113	3.13	299.4
	November	3.04	119	3.17	299.8
1964	January	3.06	120	3.09	300.8
	March	3.07	137	2.81	301.8
	May	3.08	136	2.51	302.1
	July	3.08	139	2.59	304.1
	September	3.12	164	2.54	306.1
	November	3.12	160	2.58	307.7

TABLE A-11

SALT LAKE CITY, UTAH

Time Period		Average Hourly Earnings of Production Workers in Manufacturing (dollars per hour)	Seasonally Adjusted Help-Wanted Index (1957-1959= 100)	Seasonally Adjusted Unemployment Rate (per cent)	Seasonally Adjusted Size of Labor Force (thousands)
1960	January	2.28	126	4.61	162.1
	March	2.30	126	3.20	159.9
	May	2.34	119	3.14	161.8
	July	2.38	111	3.03	161.8
	September	2.41	107	3.52	164.1
	November	2.38	111	3.83	166.5
1961	January	2.43	112	3.86	166.7
	March	2.44	111	4.40	167.7
	May	2.47	112	4.42	168.7
	July	2.51	121	3.97	169.2
	September	2.48	135	4.42	172.4
	November	2.47	133	3.43	172.7
1962	January	2.55	140	3.27	177.5
	March	2.56	145	3.13	179.6
	May	2.55	138	3.10	182.0
	July	2.57	127	3.00	184.8
	September	2.57	119	2.84	185.6
	November	2.54	126	3.50	185.0
1963	January	2.61	130	3.72	187.9
	March	2.62	141	3.47	188.6
	May	2.58	131	3.38	190.3
	July	2.64	132	4.16	192.3
	September	2.60	141	3.61	190.4
	November	2.59	138	3.69	193.6
1964	January	2.63	141	3.71	190.6
	March	2.64	137	3.87	192.5
	May	2.67	126	4.04	192.7
	July	2.67	141	4.50	194.2
	September	2.66	141	4.18	194.1
	November	2.67	140	4.68	197.0

TABLE A-12

PITTSBURG, PENNSYLVANIA

Time Period		Average Hourly Earnings of Production Workers in Manufacturing (dollars per hour)	Seasonally Adjusted Help-Wanted Index (1957-1959= 100)	Seasonally Adjusted Unemployment Rate (per cent)	Seasonally Adjusted Size of Labor Force (thousands)
1960	January	2.86	102	6.66	950.0
	March	2.84	102	7.04	956.7
	May	2.80	101	7.92	958.7
	July	2.76	83	9.72	948.4
	September	2.76	82	10.92	950.2
	November	2.77	76	10.75	946.6
1961	January	2.82	69	11.76	952.6
	March	2.82	71	11.77	948.8
	May	2.85	67	12.42	950.2
	July	2.84	74	11.18	943.4
	September	2.85	77	10.05	944.2
	November	2.91	81	9.64	938.6
1962	January	2.95	91	8.89	930.5
	March	2.96	89	8.87	932.7
	May	2.93	84	9.59	931.6
	July	2.92	86	8.75	933.1
	September	2.94	79	9.48	926.1
	November	2.93	79	9.96	931.6
1963	January	2.96	84	9.64	921.5
	March	2.99	85	8.80	913.1
	May	3.03	84	7.76	912.8
	July	3.02	96	7.10	913.7
	September	3.00	90	7.18	911.6
	November	3.01	91	7.20	908.0
1964	January	3.05	95	7.03	912.3
	March	3.06	101	7.00	915.0
	May	3.07	103	6.01	910.3
	July	3.08	115	5.21	905.4
	September	3.11	122	3.98	900.2
	November	3.10	124	3.94	898.6

TABLE A-13

SAN DIEGO, CALIFORNIA

Time Period		Average Hourly Earnings of Production Workers in Manufacturing (dollars per hour)	Seasonally Adjusted Help-Wanted Index (1957-1959=100)	Seasonally Adjusted Unemployment Rate (per cent)	Seasonally Adjusted Size of Labor Force (thousands)
1960	January	2.67	109	4.79	328.5
	March	2.68	104	5.47	331.6
	May	2.71	99	5.78	331.2
	July	2.72	99	6.51	332.0
	September	2.77	92	7.35	332.9
	November	2.74	93	7.19	332.3
1961	January	2.81	92	7.81	332.7
	March	2.83	95	7.78	338.6
	May	2.78	92	7.73	340.8
	July	2.82	90	7.00	340.9
	September	2.84	97	6.86	341.2
	November	2.88	102	6.97	342.8
1962	January	2.92	101	7.28	340.9
	March	2.95	100	7.70	341.1
	May	2.97	100	7.62	338.9
	July	2.97	90	8.39	339.3
	September	3.00	100	7.94	340.9
	November	2.97	92	8.05	339.0
1963	January	3.01	87	7.67	340.0
	March	3.02	88	7.46	336.9
	May	3.03	89	7.70	337.8
	July	3.11	100	7.38	338.0
	September	3.12	115	7.35	337.3
	November	3.09	114	7.72	338.5
1964	January	3.12	97	7.38	340.3
	March	3.11	97	7.35	338.1
	May	3.12	104	7.27	338.4
	July	3.11	114	7.34	338.7
	September	3.15	100	7.50	339.0
	November	3.17	98	8.15	340.2

TABLE A-14

MIAMI, FLORIDA

Time Period		Average Hourly Earnings of Production Workers in Manufacturing (dollars per hour)	Seasonally Adjusted Help-Wanted Index (1957-1959=100)	Seasonally Adjusted Unemployment Rate (per cent)	Seasonally Adjusted Size of Labor Force (thousands)
1960	January	1.83	113	4.64	422.4
	March	1.82	102	5.77	413.7
	May	1.86	102	4.86	417.6
	July	1.90	87	4.95	414.9
	September	1.90	79	5.18	414.6
	November	1.87	83	6.24	427.0
1961	January	1.89	75	6.31	431.0
	March	1.90	76	7.45	434.8
	May	1.89	62	7.32	433.0
	July	1.92	85	6.99	433.8
	September	1.95	87	6.35	430.3
	November	1.97	86	6.93	435.1
1962	January	1.97	94	6.39	434.0
	March	1.99	99	5.81	436.6
	May	1.98	92	8.25	445.7
	July	2.01	84	8.92	444.6
	September	2.03	88	9.79	452.5
	November	2.01	82	6.56	430.9
1963	January	2.01	91	9.85	444.0
	March	2.00	95	9.79	444.8
	May	2.02	92	8.14	440.1
	July	2.01	98	8.34	445.9
	September	2.03	104	8.14	442.6
	November	2.01	101	9.06	449.3
1964	January	2.01	119	7.14	435.8
	March	2.01	112	6.72	431.7
	May	2.03	107	5.97	432.8
	July	2.08	107	6.58	433.5
	September	2.08	126	5.16	436.0
	November	2.08	126	5.38	440.2

TABLE A-15

PROVIDENCE - PAWTUCKET, RHODE ISLAND

Time Period		Average Hourly Earnings of Production Workers in Manufacturing (dollars per hour)	Seasonally Adjusted Help-Wanted Index (1957-1959= 100)	Seasonally Adjusted Unemployment Rate (per cent)	Seasonally Adjusted Size of Labor Force (thousands)
1960	January	1.88	137	6.96	351.2
	March	1.85	129	6.76	350.4
	May	1.87	141	7.18	350.0
	July	1.87	114	7.08	350.0
	September	1.87	112	7.39	350.5
	November	1.90	97	7.63	348.6
1961	January	1.90	96	7.69	348.5
	March	1.88	98	8.15	349.9
	May	1.90	102	8.18	349.3
	July	1.92	110	7.28	348.3
	September	1.93	133	7.26	348.7
	November	1.94	155	6.52	257.8
1962	January	1.95	136	6.29	355.2
	March	1.96	148	6.38	357.6
	May	1.97	154	6.58	357.9
	July	1.99	147	6.61	358.9
	September	2.01	149	6.80	359.4
	November	2.02	136	7.29	356.9
1963	January	2.01	138	7.06	359.0
	March	2.03	135	6.99	358.7
	May	2.05	124	6.88	361.7
	July	2.05	132	7.09	362.9
	September	2.06	124	6.69	363.4
	November	2.07	107	6.64	360.4
1964	January	2.09	126	6.87	363.0
	March	2.09	143	6.34	361.3
	May	2.11	136	6.07	360.5
	July	2.11	133	6.42	360.9
	September	2.10	147	6.41	362.0
	November	2.12	153	5.85	357.0

TABLE A-16

DETROIT, MICHIGAN

Time Period		Average Hourly Earnings of Production Workers in Manufacturing (dollars per hour)	Seasonally Adjusted Help-Wanted Index (1957-1959=100)	Seasonally Adjusted Unemployment Rate (per cent)	Seasonally Adjusted Size of Labor Force (thousands)
1960	January	2.95	133	5.14	1423.8
	March	2.91	128	5.13	1432.8
	May	2.91	112	6.95	1425.9
	July	2.92	91	6.97	1416.8
	September	2.93	89	7.80	1421.2
	November	2.92	77	8.81	1424.4
1961	January	2.93	65	10.61	1430.2
	March	2.95	55	12.64	1434.2
	May	2.97	57	12.09	1429.5
	July	2.98	62	9.82	1422.8
	September	2.97	69	10.45	1418.0
	November	3.07	77	9.13	1401.6
1962	January	3.04	88	7.75	1391.9
	March	3.04	95	7.29	1387.1
	May	3.05	93	7.40	1382.6
	July	3.06	113	5.77	1372.7
	September	3.12	119	6.10	1376.4
	November	3.15	127	5.93	1377.2
1963	January	3.12	107	5.41	1385.7
	March	3.13	121	5.00	1386.9
	May	3.14	102	4.76	1387.4
	July	3.16	119	4.53	1396.1
	September	3.21	117	4.56	1405.8
	November	3.27	150	4.47	1416.7
1964	January	3.25	156	4.27	1413.0
	March	3.24	153	3.77	1419.9
	May	3.27	172	3.61	1434.2
	July	3.26	188	4.88	1458.6
	September	3.32	193	3.21	1454.6
	November	3.28	198	3.88	1476.8

TABLE A-17

PHILADELPHIA, PENNSYLVANIA

Time Period		Average Hourly Earnings of Production Workers in Manufacturing (dollars per hour)	Seasonally Adjusted Help-Wanted Index (1957-1959=100)	Seasonally Adjusted Unemployment Rate (per cent)	Seasonally Adjusted Size of Labor Force (thousands)
1960	January	2.35	126	5.86	1836.1
	March	2.35	125	6.00	1841.7
	May	2.36	119	5.91	1845.4
	July	2.39	110	6.04	1844.0
	September	2.40	99	6.47	1845.6
	November	2.39	97	6.58	1852.8
1961	January	2.41	92	6.82	1857.1
	March	2.42	93	7.33	1865.8
	May	2.44	90	7.68	1869.5
	July	2.46	95	7.57	1875.4
	September	2.49	100	7.15	1877.4
	November	2.48	106	6.76	1873.7
1962	January	2.50	111	6.55	1865.7
	March	2.49	112	6.40	1877.6
	May	2.50	115	6.27	1880.2
	July	2.53	107	6.38	1880.3
	September	2.53	103	6.38	1885.2
	November	2.53	106	6.69	1883.4
1963	January	2.55	101	6.68	1881.4
	March	2.54	102	6.59	1874.4
	May	2.55	97	6.49	1876.8
	July	2.57	107	6.52	1879.5
	September	2.60	100	6.51	1874.5
	November	2.61	101	6.51	1878.7
1964	January	2.63	120	6.51	1889.8
	March	2.62	108	6.23	1881.4
	May	2.65	102	5.99	1877.9
	July	2.66	118	6.84	1875.6
	September	2.71	130	5.40	1875.3
	November	2.68	142	5.25	1881.4

TABLE A-18

SAN BERNARDINO, CALIFORNIA

Time Period		Average Hourly Earnings of Production Workers in Manufacturing (dollars per hour)	Seasonally Adjusted Help-Wanted Index (1957-1959= 100)	Seasonally Adjusted Unemployment Rate (per cent)	Seasonally Adjusted Size of Labor Force (thousands)
1960	January	2.65	110	5.42	271.7
	March	2.65	116	5.83	270.4
	May	2.66	107	6.12	271.6
	July	2.67	102	6.59	271.7
	September	2.67	98	7.02	274.4
	November	2.68	98	7.64	275.0
1961	January	2.71	102	7.99	277.8
	March	2.70	108	8.04	277.6
	May	2.75	100	8.19	275.4
	July	2.76	109	7.54	276.7
	September	2.78	109	6.76	278.6
	November	2.81	121	6.29	278.8
1962	January	2.81	122	5.87	280.4
	March	2.82	109	6.25	280.0
	May	2.84	118	5.79	281.7
	July	2.82	110	5.84	284.1
	September	2.81	119	5.80	283.9
	November	2.81	121	5.99	283.1
1963	January	2.84	124	5.86	289.3
	March	2.83	127	5.91	293.3
	May	2.87	124	5.79	294.3
	July	2.90	125	5.82	297.5
	September	2.88	135	6.27	298.6
	November	2.89	126	5.93	304.3
1964	January	2.89	140	6.14	299.7
	March	2.91	139	5.59	303.2
	May	2.94	140	5.95	309.6
	July	2.98	156	6.05	311.3
	September	3.01	140	6.34	313.8
	November	2.95	147	6.29	319.9

TABLE A-19

NEWARK, NEW JERSEY

Time Period		Average Hourly Earnings of Production Workers in Manufacturing (dollars per hour)	Seasonally Adjusted Help-Wanted Index (1957-1959=100)	Seasonally Adjusted Unemployment Rate (per cent)	Seasonally Adjusted Size of Labor Force (thousands)
1960	January	2.37	133	6.13	798.4
	March	2.35	130	6.19	813.0
	May	2.39	125	6.13	809.2
	July	2.40	102	6.35	806.6
	September	2.40	112	6.41	809.1
	November	2.40	102	6.72	826.3
1961	January	2.41	100	6.34	818.2
	March	2.41	93	6.72	829.1
	May	2.44	103	7.27	832.9
	July	2.45	105	6.89	832.0
	September	2.43	116	6.64	831.4
	November	2.43	135	6.28	824.1
1962	January	2.46	97	5.96	823.4
	March	2.46	139	5.78	832.6
	May	2.48	133	5.97	833.1
	July	2.48	119	5.69	832.1
	September	2.48	128	5.77	836.0
	November	2.48	143	5.69	832.6
1963	January	2.53	146	6.09	828.0
	March	2.54	146	6.10	822.0
	May	2.56	120	5.80	819.5
	July	2.58	102	6.06	822.7
	September	2.58	110	6.12	821.2
	November	2.60	104	6.20	815.4
1964	January	2.65	117	6.36	830.2
	March	2.64	124	6.08	818.6
	May	2.66	123	5.58	818.1
	July	2.66	113	5.69	819.5
	September	2.68	131	5.52	819.1
	November	2.66	133	5.31	817.4

TABLE A-20

BIRMINGHAM, ALABAMA

Time Period		Average Hourly Earnings of Production Workers in Manufacturing (dollars per hour)	Seasonally Adjusted Help-Wanted Index (1957-1959=100)	Seasonally Adjusted Unemploy-ment Rate (per cent)	Seasonally Adjusted Size of Labor Force (thousands)
1960	January	2.58	100	5.90	249.1
	March	2.54	93	6.40	248.7
	May	2.52	94	6.51	249.8
	July	2.55	92	6.77	252.1
	September	2.51	84	7.61	251.1
	November	2.46	85	7.83	251.7
1961	January	2.55	82	7.60	248.0
	March	2.53	85	8.99	248.9
	May	2.55	84	8.71	249.4
	July	2.59	85	8.07	247.2
	September	2.60	99	7.22	245.4
	November	2.61	97	6.41	244.6
1962	January	2.71	100	6.28	243.1
	March	2.66	100	6.22	244.1
	May	2.67	106	6.02	244.0
	July	2.65	106	6.74	243.6
	September	2.64	100	6.28	244.4
	November	2.62	105	6.37	244.7
1963	January	2.70	110	6.24	246.4
	March	2.72	112	5.62	244.6
	May	2.72	120	5.47	242.4
	July	2.77	114	4.72	242.9
	September	2.73	116	4.69	243.5
	November	2.70	122	4.81	242.8
1964	January	2.77	117	4.80	245.4
	March	2.72	122	4.78	243.9
	May	2.78	132	4.01	244.2
	July	2.77	118	3.83	243.5
	September	2.80	132	3.55	243.1
	November	2.79	146	3.24	245.4

TABLE A-21

SEATTLE, WASHINGTON

Time Period		Average Hourly Earnings of Production Workers in Manufacturing (dollars per hour)	Seasonally Adjusted Help-Wanted Index (1957-1959=100)	Seasonally Adjusted Unemployment Rate (per cent)	Seasonally Adjusted Size of Labor Force (thousands)
1960	January	2.56	101	5.51	455.0
	March	2.58	102	5.90	454.9
	May	2.60	96	5.80	454.8
	July	2.61	91	5.75	457.4
	September	2.64	89	6.01	452.5
	November	2.67	94	6.60	458.5
1961	January	2.68	91	6.96	461.0
	March	2.67	83	7.43	461.5
	May	2.71	86	7.72	464.6
	July	2.69	100	6.04	464.0
	September	2.76	100	6.04	469.6
	November	2.81	98	5.60	476.7
1962	January	2.83	109	5.39	483.9
	March	2.80	120	4.99	489.6
	May	2.85	121	4.56	500.1
	July	2.78	109	5.21	506.8
	September	2.79	104	4.49	503.8
	November	2.80	103	5.06	497.8
1963	January	2.81	94	5.28	495.7
	March	2.83	91	5.28	496.2
	May	2.84	92	5.54	492.2
	July	2.92	101	6.37	491.5
	September	2.93	96	7.45	496.9
	November	2.98	103	6.76	495.4
1964	January	2.96	99	6.46	493.0
	March	2.97	93	6.65	491.3
	May	3.02	95	6.73	487.0
	July	3.02	103	6.59	485.1
	September	3.01	103	6.69	483.4
	November	3.08	107	5.41	486.4

TABLE A-22

NEW ORLEANS, LOUISIANA

Time Period		Average Hourly Earnings of Production Workers in Manufacturing (dollars per hour)	Seasonally Adjusted Help-Wanted Index (1957-1959=100)	Seasonally Adjusted Unemployment Rate (per cent)	Seasonally Adjusted Size of Labor Force (thousands)
1960	January	2.17	91	5.75	341.4
	March	2.22	91	5.60	338.5
	May	2.24	88	5.76	338.0
	July	2.26	79	5.89	340.5
	September	2.25	73	5.89	339.3
	November	2.24	71	6.09	338.5
1961	January	2.27	65	6.34	340.2
	March	2.25	66	7.21	338.5
	May	2.32	64	7.25	338.4
	July	2.34	69	7.15	337.9
	September	2.35	69	7.36	338.4
	November	2.37	73	7.24	339.1
1962	January	2.39	78	6.76	339.0
	March	2.39	76	6.71	337.8
	May	2.41	77	6.53	337.9
	July	2.46	77	6.55	340.1
	September	2.49	78	6.33	343.1
	November	2.50	75	6.23	344.3
1963	January	2.46	74	6.25	346.9
	March	2.51	91	5.74	351.3
	May	2.50	85	5.50	352.6
	July	2.52	86	5.24	355.6
	September	2.58	95	5.13	356.0
	November	2.53	101	4.96	358.7
1964	January	2.54	104	4.90	358.9
	March	2.59	101	4.49	361.5
	May	2.58	116	4.58	364.7
	July	2.62	110	4.51	364.3
	September	2.64	128	4.37	366.0
	November	2.62	128	4.30	367.6

APPENDIX B

TABLE B-1

SELECTED STATISTICS FROM AN AUTOREGRESSIVE LEAST SQUARES DISTRIBUTED LAG MODEL CONTAINING TWO LAG PARAMETERS IN THE ESTIMATION OF LABOR SUPPLY FUNCTIONS FOR TWENTY-TWO LABOR MARKET AREAS, 1960 - 1964

Labor Market Area	Regression Coefficients and Calculated Student t Statistics							
	a_0	a_1	b_1	b_2	λ	μ	β	R^2
Washington, District of Columbia	22.741	117.315	0.148	11.091	0.510	0.678	-0.070	0.9936
		(3.07)***	(1.88)*	(1.76)*	(2.29)**	(2.32)**	(0.23)	
Richmond, Virginia	1.045	7.620	0.004	0.399	0.922	-0.205	-0.130	0.9863
		(1.11)	(0.20)	(0.49)	(9.73)***	(0.11)	(0.07)	
Rochester, New York	- 4.533	27.870	-0.080	- 2.662	0.755	-0.077	-0.070	0.9714
		(1.62)	(0.59)	(0.71)	(4.73)***	(0.07)	(0.06)	
Denver, Colorado	41.292	27.079	0.124	1.060	0.155	0.838	-0.224	0.9748
		(1.37)	(3.22)***	(0.56)	(0.36)	(12.09)***	(0.50)	
Omaha, Nebraska	66.701	2.917	0.016	- 0.815	0.664	-0.289	0.147	0.7498
		(0.54)	(0.49)	(0.46)	(2.45)**	(0.51)	(0.20)	
Jacksonville, Florida	47.757	7.765	-0.036	0.615	0.191	0.491	0.307	0.6959
		(0.71)	(0.65)	(0.47)	(0.15)	(0.96)	(0.19)	
Atlanta, Georgia	52.651	17.389	-0.023	- 3.790	-0.298	0.960	-0.095	0.9798
		(0.95)	(0.33)	(2.48)**	(0.33)	(16.40)***	(0.10)	

TABLE B-1 (continued)

Labor Market Area	Regression Coefficients and Calculated Student t Statistics							
	a_0	a_1	b_1	b_2	λ	μ	β	R^2
Columbus, Ohio	77.268	16.102 (1.32)	0.037 (1.13)	-0.689 (0.36)	0.684 (3.77)***	-0.231 (0.32)	-0.100 (0.11)	0.9585
Oklahoma City, Oklahoma	4.694	- 4.220 (0.36)	-0.010 (0.80)	-0.477 (0.58)	1.018 (10.34)***	-0.258 (0.80)	0.380 (1.17)	0.9955
Dayton, Ohio	80.524	20.048 (1.33)	0.064 (1.73)*	0.965 (1.02)	0.455 (1.24)	0.213 (0.49)	-0.069 (0.20)	0.9631
Salt Lake City, Utah	- 13.954	19.124 (1.96)*	-0.046 (1.18)	1.135 (1.71)	0.827 (10.92)***	-0.649 (3.99)***	0.474 (2.04)*	0.9890
Pittsburgh, Pennsylvania	712.755	- 52.129 (1.45)	0.245 (1.00)	4.347 (2.19)**	0.398 (1.25)	0.128 (0.34)	-0.220 (0.59)	0.9567
San Diego, California	71.136	- 2.698 (0.24)	0.028 (0.54)	1.036 (0.80)	0.286 (0.42)	0.745 (3.71)***	-0.264 (0.56)	0.7291
Miami, Florida	144.959	10.165 (0.56)	0.161 (1.64)	4.688 (6.35)***	0.577 (1.88)*	-0.032 (0.22)	0.030 (0.09)	0.8695
Providence-Pawtucket, Rhode Island	80.818	15.994 (0.70)	0.087 (2.05)*	1.431 (0.90)	0.571 (1.42)	0.490 (1.45)	-0.530 (1.90)*	0.8446
Detroit, Michigan	119.049	- 89.724 (1.34)	0.338 (1.58)	3.017 (1.73)*	0.463 (0.94)	0.870 (5.36)***	-0.128 (0.27)	0.9315

TABLE B-1 (continued)

Labor Market Area	Regression Coefficients and Calculated Student t Statistics							
	a_0	a_1	b_1	b_2	λ	μ	β	R^2
Philadelphia, Pennsylvania	347.610	8.021 (0.33)	0.355 (2.37)**	10.098 (2.31)**	0.812 (5.19)***	0.126 (0.45)	-0.282 (0.85)	0.8695
San Bernardino, California	28.122	4.202 (0.31)	-0.051 (0.61)	-0.270 (0.15)	1.038 (10.85)***	-0.133 (0.09)	-0.171 (0.12)	0.9733
Newark, New Jersey	226.546	- 5.901 (0.58)	0.103 (1.40)	10.041 (2.36)**	0.770 (4.53)***	-0.425 (1.72)	0.177 (0.44)	0.6017
Birmingham, Alabama	17.221	3.929 (0.88)	0.007 (0.13)	1.289 (1.79)*	0.895 (5.65)***	0.153 (0.35)	-0.416 (1.06)	0.7781
Seattle, Washington	28.499	- 2.530 (0.12)	0.343 (3.06)***	0.533 (0.43)	0.017 (0.00)	0.865 (15.82)***	0.038 (0.00)	0.9577
New Orleans, Louisiana	76.029	13.339 (1.31)	0.051 (1.01)	-2.039 (1.97)*	0.437 (1.94)*	0.673 (4.37)***	-0.311 (1.16)	0.9860

Notes:

The calculated student t statistic is in parenthesis.

* Significantly different from zero at the .10 level

** Significantly different from zero at the .05 level

*** Significantly different from zero at the .01 level

TABLE B-1 (continued)

Labor Supply Function Estimated:

$$Y_t = a_0 (1 - \lambda)(1 - \mu)(1 - \beta) + a_1 X_{i1t} - (\mu + \beta) a_1 X_{i1t-1} + \mu\beta a_1 X_{i1t-2} + b_1 X_{j1t}$$

$$- (\lambda + \beta) b_1 X_{j1t-1} + \lambda\beta b_1 X_{j1t-2} + b_2 X_{j2t} - (\lambda + \beta) b_2 X_{j2t-1} + \lambda\beta b_2 X_{j2t-2}$$

$$+ (\lambda + \mu + \beta) Y_{t-1} - \left[(\lambda + \mu) \beta + \lambda\mu\right] Y_{t-2} + \lambda\mu\beta Y_{t-3} + e_t$$

Y_t = Seasonally Adjusted Size of Area Labor Force (in thousands)

X_{i1} = Average Hourly Earnings of Production Workers in Manufacturing (dollars per hour)

X_{j1} = Seasonally Adjusted Help-wanted Index (1957 - 1959 = 100)

X_{j2} = Seasonally Adjusted Unemployment Rate (per cent)

λ = Lag Coefficient Associated with Independent Variable(s) X_{it}

μ = Lag Coefficient Associated with Independent Variable(s) X_{jt}

β = First Order Autocorrelation Coefficient

R^2 = Coefficient of Determination

APPENDIX B

TABLE B-2

SELECTED STATISTICS FROM AN AUTOREGRESSIVE LEAST SQUARES DISTRIBUTED LAG MODEL CONTAINING TWO LAG PARAMETERS IN THE ESTIMATION OF LABOR SUPPLY FUNCTIONS FOR TWENTY-TWO LABOR MARKET AREAS, 1960 - 1964

Labor Market Area	Regression Coefficients and Calculated Student t Statistics						
	a_0	a_1	b_1	λ	μ	β	R^2
Washington, District of Columbia	34.582	0.054	15.970	0.950	-0.081	0.208	0.9924
		(0.59)	(2.74)**	(13.00)***	(0.25)	(0.54)	
Richmond, Virginia	5.943	0.015	0.499	0.976	-0.234	-0.149	0.9866
		(1.38)	(0.70)	(25.24)***	(0.24)	(0.15)	
Rochester, New York	46.155	-0.053	-2.809	-0.145	0.911	-0.158	0.9721
		(0.54)	(1.88)*	(0.09)	(13.14)***	(0.10)	
Denver, Colorado	48.871	0.108	0.286	0.864	0.191	-0.256	0.9722
		(2.84)***	(0.13)	(20.07)***	(0.47)	(0.60)	
Omaha, Nebraska	76.867	-0.028	-1.380	0.715	-0.187	-0.055	0.7482
		(0.79)	(0.89)	(6.07)***	(0.20)	(0.06)	
Jacksonville, Florida	57.815	-0.033	0.338	0.492	0.137	0.306	0.6884
		(0.66)	(0.27)	(1.41)	(0.03)	(0.07)	
Atlanta, Georgia	58.591	0.165	-3.700	-0.421	0.927	0.165	0.9827
		(2.12)**	(3.34)***	(1.85)*	(18.41)***	(0.51)	

TABLE B-2 (continued)

Labor Market Area	Regression Coefficients and Calculated Student t Statistics						
	a_0	a_1	b_1	λ	μ	β	R^2
Columbus, Ohio	72.160	0.034 (1.41)	-1.041 (0.55)	0.827 (8.73)***	-0.168 (0.09)	-0.208 (0.11)	0.9482
Oklahoma City, Oklahoma	3.507	-0.011 (0.97)	-0.101 (0.13)	-0.234 (0.72)	0.368 (1.12)	0.986 (48.33)***	0.9954
Dayton, Ohio	27.713	0.028 (1.27)	0.232 (0.26)	0.922 (8.95)***	-0.177 (0.05)	-0.139 (0.04)	0.9558
Salt Lake City, Utah	8.673	0.073 (2.64)**	1.345 (1.87)*	0.915 (32.53)***	-0.611 (3.31)***	0.220 (0.96)	0.9889
Pittsburgh, Pennsylvania	317.974	0.147 (0.60)	4.205 (1.98)*	0.459 (3.44)***	0.500 (3.01)***	-0.424 (1.84)*	0.9494
San Diego, California	74.867	-0.0004 (0.007)	0.830 (0.67)	-0.187 (0.31)	0.736 (4.15)***	0.243 (0.32)	0.7252
Miami, Florida	150.723	0.196 (2.68)**	4.781 (6.59)***	0.098 (0.35)	-0.037 (0.27)	0.580 (2.09)**	0.8686
Providence-Pawtucket, Rhode Island	68.191	0.073 (1.84)*	1.010 (0.65)	0.769 (6.42)***	0.378 (0.99)	-0.549 (2.00)*	0.8382
Detroit, Michigan	- 1.418	0.132 (3.11)***	5.565 (4.94)***	0.992 (13.85)***	-0.218 (1.13)	0.349 (1.53)	0.9621

TABLE B-2 (continued)

Labor Market Area	Regression Coefficients and Calculated Student t Statistics						
	a_0	a_1	b_1	λ	μ	β	R^2
Philadelphia, Pennsylvania	368.831	0.333 (2.49)**	2.712 (1.37)	-0.157 (0.41)	0.788 (8.67)***	0.148 (0.33)	0.8584
San Bernardino, California	-22.336	-0.058 (0.74)	-0.668 (0.41)	-0.083 (0.09)	-0.180 (0.22)	0.107 (0.36)	0.9732
Newark, New Jersey	122.286	-0.069 (0.87)	8.975 (2.12)**	0.899 (5.87)***	-0.317 (0.84)	-0.059 (0.12)	0.5654
Birmingham, Alabama	32.804	0.032 (1.41)	1.441 (2.20)**	0.873 (6.20)***	0.134 (0.38)	-0.431 (1.40)	0.7939
Seattle, Washington	37.937	0.380 (3.68)***	2.115 (1.51)	0.838 (18.41)***	0.042 (0.06)	-0.008 (0.01)	0.9624
New Orleans, Louisiana	70.603	0.092 (1.73)*	-2.033 (2.32)**	0.372 (1.31)	0.770 (5.01)***	-0.252 (0.88)	0.9852

Notes:

The calculated student t statistic is in parenthesis
* Significantly different from zero at the .10 level
** Significantly different from zero at the .05 level
*** Significantly different from zero at the .01 level

TABLE B-2 (continued)

Labor Supply Function Estimated:

$$
\begin{aligned}
Y_t = {} & a_0 (1 - \lambda)(1 - \mu)(1 - \beta) + a_1 X_{i1t} - (\mu + \beta)\, a_1 X_{i1t-1} + \mu\beta a_1 X_{i1t-2} + b_1 X_{j1t} \\
& - (\lambda + \beta)\, b_1 X_{j1t-1} + \lambda\beta b_1 X_{j1t-2} + (\lambda + \mu + \beta)\, Y_{t-1} - \left[(\lambda + \mu)\beta + \lambda\mu\right] Y_{t-2} \\
& + \lambda\mu\beta Y_{t-3} + e_t
\end{aligned}
$$

Y_t = Seasonally Adjusted Size of Area Labor Force (in thousands)

X_{i1} = Seasonally Adjusted Help-wanted Index (1957 - 1959 = 100)

X_{j1} = Seasonally Adjusted Unemployment Rate (per cent)

λ = Lag Coefficient Associated with Independent Variable(s) X_{it}

μ = Lag Coefficient Associated with Independent Variable(s) X_{jt}

β = First Order Autocorrelation Coefficient

R^2 = Coefficient of Determination

VITA

Maurice Pfannestiel

Candidate for the Degree of

Doctor of Philosophy

Thesis: A DISTRIBUTED LAG ANALYSIS OF ADJUSTMENT OF SIZE OF LABOR FORCE IN SELECTED MAJOR LABOR MARKET AREAS IN THE UNITED STATES

Major Field: Economics

Biographical:

Personal Data: Born at Munjor, Kansas, December 3, 1938, the son of Clem and Rose Befort Pfannestiel.

Education: Attended grade school in Hays, Kansas; graduated from Hays High School in 1956; received the Bachelor of Arts degree from Fort Hays Kansas State College, with a major in Economics, in May, 1960; received the Master of Science degree from the Oklahoma State University, with a major in Economics, in May, 1966; completed requirements for the Doctor of Philosophy degree in May, 1967.

Professional Experience: Employed as a graduate teaching assistant by the Oklahoma State University from 1960 to 1963; active duty service with the United States Army in 1963; employed as an instructor of Accounting by the Oklahoma State University from 1964 to 1966; employed as an assistant professor of Economics by the Wichita State University in 1966-1967.